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Handbook for Air Toxics Emission Inventory Development

Volume I: Stationary Sources

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TABLE OF ACRONYMS, ABBREVIATIONS, AND TERMS

AFS	Airs Facility Subsystem
AIRS	Aerometric Information Retrieval System
AMTIC	Ambient Monitoring Technology Information Center
AP-42	Compilation of Air Pollutant Emission Factors
ACT	available control technique
BID	background information document
CAA	Clean Air Act
CAAA	1990 Clean Air Act Amendments
CARB	California Air Resources Board
CAS No.	Chemical Abstract Services Registry Number
CATC	Clean Air Technology Center
CBI	confidential business information
CFR	Code of Federal Regulations
CHIEF	Clearinghouse for Inventories and Emission Factors
CPDS	Certified Product Data Sheet
CTG	control techniques guideline
EDI	electronic data interchange
EFIG	Emission Factor and Inventory Group
EI	emission inventory
EIIP	Emission Inventory Improvement Program
EMTIC	Emission Measurement Technical Information Center
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESD	Emission Standards Division
FIRE	Factor Information Retrieval System

TABLE OF ACRONYMS, ABBREVIATIONS, AND TERMS (CONTINUED)

FTP	file transfer protocol
FY	fiscal year
GLC	Great Lakes Commission
GPO	Government Printing Office
GPRA	Government Performance and Results Act
HAP	hazardous air pollutant
HAP-PRO	Hazardous Air Pollutant Program
IRIS	Integrated Risk Information System
L&E	locating and estimating
LAEEM	Landfill Air Emissions Estimation Model
MACT	Maximum Achievable Control Technology
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NESHAP	National Emission Standards for Hazardous Air Pollutants
NET	National Emissions Trend
NSPS	New Source Performance Standards
NTI	National Toxics Inventory
NTIS	National Technical Information Service
OAQPS	Office of Air Quality Planning and Standards
PAH	polycyclic aromatic hydrocarbon
POM	polycyclic organic matter
PM	particulate matter
QA/QC	quality assurance/quality control
QAP	quality assurance plan

TABLE OF ACRONYMS, ABBREVIATIONS, AND TERMS (CONTINUED)

RAPIDS	Regional Air Pollutant Inventory Development System
RMP	Risk Management Plan
SAEWG	Standing Air Emissions Work Group
SARA	Superfund Amendments and Reauthorization Act
SCC	Source Classification Code
SIC	Standard Industrial Classification
SOCMI	synthetic organic chemical manufacturing industry
STAPPA/ALAPCO	State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
2,3,7,8-TCDF TEQ	2,3,7,8-tetrachlorodibenzofuran toxic equivalent
TRI	Toxic Release Inventory
TRIS	Toxic Release Inventory System
TSDF	Treatment, Storage, and Disposal Facility
TTN	Technology Transfer Network
UATW	Unified Air Toxics Web site
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 How Will This Document Help Me?

This document will assist state and local air pollution control agency personnel in compiling an inventory of air toxics emissions from stationary (major and area)* sources. In this document, major and area sources are discussed together. Under ideal circumstances, all stationary sources would be considered major sources for purposes of developing emission inventories. In reality, however, only sources emitting more than a specified cutoff level of a hazardous air pollutant (HAP) or combination of HAPs are considered major sources. Major sources are typically inventoried individually on a facility-by-facility basis and area sources are usually inventoried collectively.

This document describes "top-down" as well as "bottom-up" inventory preparation procedures and contains valuable information on obtaining reference materials. ***A top-down approach means emission estimates are developed using national- or regional-level activity data and some measure of emissions that can be applied to these data. A bottom-up approach means estimates are developed specifically for individual sources and summed to obtain state or county level emission estimates***.

This document does not include an exhaustive list of references, but rather provides a list of the most commonly used and readily available materials. This document does not mandate specific emission estimation methods, but rather presents those methods that can be used taking into consideration an agency's resources and goals.

1.2 How Is This Document Organized?

The document is divided into two major parts. The main body consists of Sections 1 through 7 and presents various tools and techniques for:

- Identifying sources and pollutants of concern;
- Locating activity data;
- Locating emission factors; and
- Estimating emissions.

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* For toxics, a major source is defined as any source (i.e., a contiguous area under common control) of toxic air pollution that emits or has the potential to emit 10 tons per year of any one hazardous air pollutant, or 25 tons per year or more of a combination of hazardous air pollutants.

Issues that should be considered when planning and compiling an air toxics inventory are also discussed.

The second part of this document provides a series of appendices that complement the main body. Each of these appendices serves as a useful source of information for some aspect of air toxics inventory preparation and compilation. The emphasis in the appendices is on providing greater detail for estimating emissions and preparing inventories than appears in the main body.

1.3 What Assumptions Were Made In Preparing This Document?

This document was prepared based on the following premises:

- That most state and local agencies focus their air toxic inventory efforts on the 188 HAPs or a subset of these HAPs. Appendices A and B list HAPs by Chemical Abstract Services (CAS) number and in alphabetical order, respectively. Appendix C includes a listing of the most commonly used HAP synonyms.

- That most state and local agencies focus their air toxic inventory efforts primarily on the source categories regulated by Maximum Achievable Control Technology (MACT) standards;

- That state and local agency personnel have access to the World Wide Web and personnel are computer literate;

- That agency personnel are responsible for determining how the inventory will be used within the state's air quality program;

- That agency personnel are responsible for establishing the priority or hierarchy of source categories and HAPs that will be inventoried; and

- That agency personnel are familiar with U.S. Environmental Protection Agency (EPA) published procedures for compiling emissions inventories.

NOTE: If you are not familiar with basic emission inventory preparation procedures, you should consult the Emission Inventory Improvement Program (EIIP) reference materials described in Appendix D or review some of the available materials on the Clearinghouse for Inventories and Emission Factors (CHIEF) World Wide Web site at http://www.epa.gov/ttn/chief/.

NOTE: All Web sites referenced in this document were valid at the time this document was prepared. If you check a Web page address and find that it has expired, check the primary Web address, or call the Info CHIEF help desk at (919) 541-5285.

1.4 Who Do I Contact for Help?

Many different people and agencies in the United States focus their efforts on air toxics issues. Various EPA offices and programs and other federal agencies as well as state agencies may also be able to provide information on characterizing and estimating emissions.

Potential sources of information among federal agencies include:
• EPA's Regional Air Toxic Coordinators (see Appendix E1 for list and contact information); • EPA's Emission Factor and Inventory Group (EFIG) within the Office of Air Quality Planning and Standards (OAQPS); • EPA's Emission Standards Division (ESD) within OAQPS; • EPA research laboratories; • The U.S. Department of Energy; and • The U.S. Department of Agriculture.

These federal agencies conduct projects to characterize and assess toxic air pollutants and may have valuable information pertaining to pollutants and source categories of interest to you. For example, during MACT standard development projects, the ESD conducts detailed studies on specific industries and typically characterizes and estimates pollutants being emitted from each piece of equipment and/or release point. During these standard development projects, source tests are typically performed and emission factors are usually developed from the data.

Potential sources of information among regional, state, and local air pollution agencies include:
• The Great Lakes Commission (GLC); • The State and Territorial Air Pollution Program Administrators (STAPPA)/Association of Local Air Pollution Control Officials (ALAPCO) membership directory on the Web at *http: www.4cleanair.org*; and • The California Air Resources Board (CARB).

Great Lakes Commission

The Great Lakes Commission (GLC), an eight-state compact agency that focuses on regional environmental quality, resources management, and economic development, is experienced in the development of a regional air toxics inventory comprising statewide inventories from eight states and one Canadian province. The multiphased "Great Lakes Regional Air Toxics Inventory" has produced two pilot inventories, and is currently developing its base year inventory. The annual inventory effort now targets 79 air toxic pollutants from point, area, and mobile sources. A protocol has been developed to guide inventory development in the states, assure consistency, and assist in identifying sources. A state-of-the-art flexible relational database system, the Regional Air Pollutant Inventory Development System (RAPIDS) has been developed and is equipped with an emission estimation module that follows the protocol. RAPIDS also contains the U.S. EPA's Factor Information Retrieval System (FIRE) emission factors and is able to incorporate state and source-specific emission factors. In the process of developing the inventory, the GLC and its member states have developed quality assurance/quality control (QA/QC) procedures. The Great Lakes states and Ontario continue to assist one another in addressing inventory development issues as the project moves forward into new territory. The protocol and the RAPIDS software are free and available on-line at *http://www.glc.org/projects/air/rapids/rapids.html*. Additional information on GLC's activities and resources can be obtained through the GLC Web site at *http://www.glc.org/*.

STAPPA/ALAPCO

STAPPA and ALAPCO are the two national associations representing air pollution control agencies in the 50 states, in 4 U.S. territories, and in over 150 major metropolitan areas across the United States. STAPPA/ALAPCO has participated in several ventures with EPA aimed at improving the understanding of air pollution issues. For example, the EIIP is a jointly sponsored effort of STAPPA/ALAPCO and EPA, and is an outgrowth of the Standing Air Emissions Work Group (SAEWG). EIIP is an excellent source of information on estimating emissions from a wide range of major, area, and mobile sources. Detailed discussions on how EIIP can help are provided throughout this document, and a complete list of EIIP documents is provided in Appendix D.

California Air Resources Board

One of CARB's stated goals is to continuously improve the understanding of the nature and causes of California's air quality problems. To achieve this goal, CARB conducts ongoing research to develop and improve on new emissions estimation methodologies and emission factors. For example, CARB developed toxics emission factors from source data collected under the Air Toxics Hot Spots Program (Assembly Bill 2588). Under this program, source test reports were validated and analyzed to produce hundreds of HAP emission factors. Additional information on the Air Toxics Hot Spots Program and other CARB activities and resources can be obtained through CARB's Web site at *http://www.arb.ca.gov/toxics/toxics.htm*.

Other Contacts

Appendices E1 and E2 contain a compilation of names and addresses that you may contact for help. In addition, several agencies provide public forums for information exchange such as a question and answer board or "chat room" on their Web site. For example, the Unified Air Toxics Web site (UATW) Forum encourages informal dialogue about air toxics information from federal, state, and local agency personnel. Anyone may submit questions, comments, and responses to the UATW Forum. However, because this is a public discussion, statements made on the UATW Forum do not necessarily represent EPA policy. Resources available through the UATW are discussed in more detail in Appendix N of this handbook. The UATW Forum can be accessed on the World Wide Web at *http://www.epa.gov/cgi-bin/netforum/uatw/a/1*.

The OAQPS Emission Inventory (EI) Public Forum is a Web-based discussion site specific to the preparation of emission inventories. Anyone may submit questions, comments, and responses. The objective is to provide an easy and effective venue for seeking and providing information about air pollution. Because this is a public discussion, statements made on the EI Forum do not necessarily represent EPA policy. You may initiate discussion by submitting a message or responding to a previous message. A submission will normally appear on the EI Forum within one working day. The EI Forum can be accessed on the World Wide Web at *http://www.epa.gov/cgi-bin/netforum/nei/a/1*.

The Technology Transfer Network (TTN) operated by OAQPS includes the CHIEF bulletin board, through which you can access the latest information on emission inventories and emission factors. The CHIEF Forum is another Web-based discussion site about air emission inventories, emission factors, and closely related subjects. You may initiate discussion by submitting a message or responding to a previous message. A submission will normally appear on the CHIEF Forum within one working day. However, because this is a public discussion, statements made on the CHIEF Forum do not necessarily represent EPA policy.

The topics discussed on the CHIEF Forum are:
• Methodologies for assembling emission inventories; • Methodologies for arriving at activity levels for area sources; and • Methodologies for developing emission factors for major and area sources.

The CHIEF Forum can be accessed on the World Wide Web at *http://www.epa.gov/cgi-bin/netforum/chief/a/1*.

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2.0 PRELIMINARY PLANNING ACTIVITIES

Many aspects of preparing an air toxics inventory are similar to those of preparing criteria pollutant inventories. Hence, basic procedures for compiling criteria pollutant inventories are not repeated here. You should refer to the EIIP reference materials listed in Appendix D or review some of the materials available on the CHIEF World Wide Web site that pertain to emission inventory development. The major difference between air toxics and criteria pollutant inventories is the pollutants covered. Because there are literally thousands of potentially toxic substances as compared to only a handful of criteria pollutants, the compilation effort can become formidable since data collection and data handling resource needs increase quickly as more and more substances are inventoried. In this regard, limiting the number of pollutants included in a detailed inventory to those of most concern may be valuable to your efforts.

The National Toxics Inventory (NTI) is a valuable source of information. The NTI can serve as a starting point in compiling a list of the source categories and the associated HAP emissions, and can provide an idea of what source categories contribute significantly to air pollution in your state. A brief overview of the NTI appears in Appendix F. NTI data can be downloaded off the World Wide Web through EPA's Web site at *http://www.epa.gov/ttn/chief/*.

2.1 How Do I Define the Purpose of an Air Toxics Emissions Inventory?

An important consideration in planning is to determine how the inventory will fit into your agency's overall air quality program. Some of the main benefits to compiling an air toxics emissions inventory include:

- Having summary information on sources and their emissions (to allow an evaluation of public health risk, or an assessment for residual risk standards development, for example);
- Satisfying federal and state regulatory standards;
- Filling in gaps and missing information not covered by other toxics programs (e.g., Form R reporting under Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 [EPCRA]); and
- Addressing environmental justice issues.

The anticipated purpose of the inventory will dictate the level of complexity and accuracy required. Major uses for air toxics inventories include but are not limited to:

- Satisfying a legislative or other mandate;

- Identifying sources and general emission strengths, patterns, and trends;
- Storing data from related programs (e.g., permit registration compilation data, emergency preparedness data, community right-to-know data);
- Siting ambient air monitors;
- Developing input files for dispersion models used in predicting ambient air quality;
- Focusing subsequent inventory work or other program development efforts;
- Identifying multiple source and multiple pollutant problem areas characterized by high additive risk; and
- Developing control strategies and new regulations.

2.2 What Resource Issues Must I Consider?

Different levels of detail are needed depending on the anticipated uses of the air toxics inventory. As discussed above, it is important that your agency be aware of resource issues and of the potential uses of the proposed inventory before embarking on any data collection effort.

2.2.1 *Internal Resources*

Internal resources and issues that your agency must consider during the inventory planning phase include:

- Availability of staff and staff expertise;
- Budget allocations;
- Schedule and milestone completion dates;
- Computer/data management capabilities;
- Data handling systems;
- Availability of emissions inventory-related data; and
- Coordination of efforts within the agency (i.e., coordinating with emission standards implementation efforts, permitting programs, etc.).

2.2.2 *External Resources*

External resources are made available to state and local agencies through the Section 105 Grant process. It is your responsibility to ensure that sufficient funds are allocated to developing a toxics inventory.

In addition to the major uses of air toxics inventories listed in Section 2.1, air toxic emission inventories are used by EPA to measure air toxic reductions under the Government Performance and Results Act (GPRA). To ensure that air toxic emission inventories are compiled, EPA makes Section 105 Grant funds available.

2.3 Why Should I Assess Existing State Inventories for Air Toxics Data?

An existing criteria pollutant inventory is a valuable starting point for compiling an inventory of HAP emissions. The first step in this process is to determine if HAPs are potentially emitted from a source emitting criteria pollutants. If, for example, a facility is a source of volatile organic compound (VOC) emissions, site-specific speciation profiles may be applied to the VOC emissions reported in the criteria pollutant inventory in order to estimate HAP emissions from that facility. Facilities contained in a criteria pollutant inventory provide an excellent base from which to build a HAP inventory. Other sources of emissions within your state must be examined to identify other HAP emission points. As a result, relying solely on the criteria pollutant inventory to identify sources of HAP emissions may result in an undercount of sources and consequently an underestimate of HAP emissions. On the other hand, every source in the criteria pollutant inventory will not necessarily emit HAP emissions. Sections 3.1 and 3.2 of this handbook discuss how to identify pollutants and sources of interest, respectively, and should be consulted.

2.4 Why Should I Conduct a Preliminary Screening Study?

It may prove helpful during the planning process to conduct a screening study before commencing with a detailed air toxics inventory. The general idea behind a screening study is to develop preliminary estimates of emissions in order for the agency to focus its program and resources on the most important sources and pollutants. A screening study should provide the agency with enough information to determine the following:

- What pollutants should be addressed in more detail?
- What source categories should be emphasized?
- What geographic areas should be included ?
- What is the relative importance of major sources and area sources?

- To what extent can the existing inventories and permit files be used as a foundation for the air toxics inventory?

- Can upset or equipment malfunction reports provide useful emissions data?

- Can Risk Management Plans (RMPs) submitted under Section 112(r) of the Clean Air Act provide useful emissions data?

- Can the Toxic Release Inventory (TRI) provide useful emission data?

Ideally, a screening study should be performed quickly and inexpensively and yet yield results that allow the agency to make confident decisions concerning program directions. More detailed discussions about conducting screening inventories can be found in the EPA report *Compiling Air Toxics Emission Inventories* (EPA, February 1990).

3.0 INVENTORY WORK PLAN

Currently, 188 HAPs are regulated under Section 112 of the Clean Air Act, and thousands of other potentially toxic substances are being emitted into the environment. Your agency may not have the resources to pursue each of these pollutants and might choose to prioritize the pollutants it needs to inventory. Moreover, some source categories may be of greater importance in your state and of more concern to your agency; therefore, the pollutants emitted from these sources would be of greater concern. As a result, identifying the pollutants and the source categories to include in your inventory is necessary early in the inventory process. Such decisions are best documented in the inventory work plan. The inventory work plan is a concise, prescriptive document that describes how you intend to develop and present the inventory. This section describes the minimum elements that you should address in an inventory work plan. Volume I of the EIIP series provides an extensive list of issues that will generally be included in a work plan.

3.1 How Do I Determine Which Pollutants To Inventory?

EPA identified a list of priority HAPs for inclusion in an air toxics inventory. The proposed EPA list is shown in Table 3.1.

There are many other resources and criteria that can be consulted to determine whether a group of HAPs should be included in your inventory to meet your individual agency/state needs and the purpose of your inventory:

- Lists developed through various CAA-prescribed regulatory programs and included in Appendix G of this document. Examples include:

  - Section 112(c)(6) list (EPA, April 1998), *http://www.epa.gov/ttn/uatw/112c6/112c6fac.html*

  - Section 112(k) Integrated Urban Air Toxics Strategy list (EPA, September 1997), *http://www.epa.gov/ttn/uatw/112k/riurban.html*

  - Section 112(m) Great Waters Program list (EPA, June 1997), *http://www.epa.gov/oar/gr8water/report97.html*

- MACT Crosswalk, a database that matches Source Classification Codes (SCCs) to MACT source categories, *http://www.epa.gov/ttn/chief/*

- Pollutants of interest from special studies such as the *Mercury Study Report to Congress* (EPA, December 1997) and the *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units* (EPA, February 1998);

Table 3-1. List of HAPs Identified by EPA as Priority HAPs

HAP	CAS #
Acetaldehyde	75070
Acrolein	107028
Acrylamide	79061
Acrylonitrile	107131
Arsenic & compounds	
Benzene	71432
Benzyl chloride	100447
Beryllium & compounds	
bis(2-ethylhexyl)phthalate	117817
1,3-Butadiene	106990
Cadmium & compounds	
Carbon tetrachloride	56235
Chlorine	7782505
Chloroform	67663
Chromium & compounds	
Coke oven emissions	
1,2-Dibromoethane	106934
1,4-Dichlorobenzene(P)	106467
1,2-Dichloropropane	78875
1,3-Dichloropropene	542756
1,4-Dioxane	123911
Ethyl acrylate	140885
Ethylene dichloride	107062
Ethylene oxide	75218
Ethylidene dichloride	75343
Formaldehyde	50000
Glycol ethers	
Hexachlorobenzene	118741
Hexachlorocyclopentadiene	77474
Hydrazine	302012
Hydrochloric acid	7647010
Lead & compounds	
Maleic anhydride	108316
Manganese & compounds	
Mercury & compounds	
Methyl bromide	74839

Table 3-1. List of HAPs Identified by EPA as Priority HAPs (Continued)

HAP	CAS #
Methyl chloride	74873
Methylene chloride	75092
MDI (methylene diphenyl diisocyanate)	101688
Nickel & compounds	
2-Nitropropane	79469
Phosgene	75445
POM (PAHs)**	
Quinoline	91225
2,3,7,8-TCDF/2,3,7,8-TCDD*	
Tetrachloroethylene	127184
Toluene	108883
Trichloroethylene	79016
Vinyl chloride	75014

a Polycyclic organic matter; polycyclic aromatic hydrocarbons. Inventory POM as the sum of the 16 PAH compounds and speciate. The 16 PAH compounds include:

Acenaphthene	Benzo(a)pyrene*	Chrysene*	Indeno(1,2,3-cd)pyrene*
Acenaphthylene	Benzo(b)fluoranthene*	Dibenz(a,h)anthracene*	Naphthalene
Anthracene	Benzo(ghi)perylene	Fluoranthene	Phenanthrene
Benz(a)anthracene*	Benzo(k)fluoranthene*	Fluorene	Pyrene

*these 7 PAHs are carcinogenic and are usually reported as the sum of 7 PAH

b 2,3,7,8-Tetrachlorodibenzofuran/2,3,7,8-tetrachlorodibenzo-p-dioxin. Inventory these HAPs as toxic equivalents (TEQs).

- Substance toxicity;
- Emissions potential;
- Potentially exposed populations;
- Lists published by EPA such as the *Initial List of Categories of Sources Under Section 112(c)(1) of the Clean Air Act Amendments* (Federal Register, July 16, 1992) and the *Chemical Emergency Preparedness Program Interim Guidance* list;
- Lists published by states with more established air toxics programs;
- Lists of substances included in the state's right-to-know program;
- Lists mandated to an agency by a legislature;
- Published studies of the noncancer health risks for air toxics;
- EPA's Integrated Risk Information System (IRIS), an electronic database containing information on human health effects that may result from exposure to 536 different chemicals, *http://www.epa.gov/ngispgm3/iris/subst-fl.htm;*
- Pollutants reported to the Toxic Release Inventory System (TRIS) under Section 313 of EPCRA; and
- Any combination of the above.

Although some air toxics are widespread, such as emissions from area sources (e.g., benzene from gasoline distribution), many compounds are industry- or source category-specific and might be emitted only by a few large producers geographically concentrated in only a few states. Your agency might choose to exclude those pollutants for which no emission factors or emission information exists until these data become available. The remaining pollutants can then be evaluated for their toxicity and substances with a fairly low toxicity could be eliminated from the final set of air toxics to be inventoried.

You are also encouraged to contact your EPA Regional Office to agree on which compounds to include in the inventory.

Pollutant Definitions

Inconsistencies in reporting can occur when:

- A single HAP has several commonly used names (synonyms). For example, perchloroethylene and tetrachloroethylene are synonyms for the same chemical;

- A HAP may have several isomers (e.g., o-, m-, and p-xylenes) and sometimes are reported individually and other times are reported as a mixed group;

- Metal compounds may be quantified and reported individually or as a group (e.g., chromium trioxide versus chromium and compounds); and

- Compounds may be mistakenly reported individually and in a group (e.g., naphthalene may be quantified and reported individually from solvent use and as part of polycyclic aromatic hydrocarbons [PAHs]).

To avoid these types of inconsistencies, during inventory work plan development, you should identify not only what pollutants will be included in the inventory, but how each compound will be reported. Compounds and/or groups of compounds to decide upon before data collection begins include:

- **Metals and other elements** - Metal compounds may be inventoried and reported as individual compounds or as combined compounds (e.g., beryllium or beryllium and compounds);

- **Glycol ethers** - The CAAA HAP list includes only the glycol ethers group, but individual compounds may be inventoried and reported. Some individual compounds in the glycol ethers group are listed in Appendix H;

- **Dioxins and furans** - Dioxins and furans can be listed in an inventory as individual congeners and/or as toxic equivalents (TEQs) of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). The toxicity equivalency factor method is used as a reference in relating the toxicity of 209 chlorinated dioxin and furan congeners in terms of equivalent amounts of 2,3,7,8-TCDD. EPA's *Locating and Estimating Air Emissions from Sources of Dioxins and Furans* (Dioxin L&E) describes this reference method in detail. A list of dioxins and furans can be found in the Dioxin L&E, which can be downloaded off the World Wide Web through EPA's Web site at *http://www.epa.gov/ttn/chief/ap42etc.html#LE*; and

- **POM/PAHs** - Polycyclic organic matter (POM) and PAHs are groups of chemicals typically emitted from combustion processes. EPA has recently published the POM L&E, which lists the different pollutants associated with this group of compounds. The complex mixture of POM consists of thousands of organic compounds. Because inventorying POM compounds individually is impossible, surrogate approaches should be used. Appendix H lists individual

constituents usually included in these groups of compounds. The POM L&E can be downloaded off the World Wide Web through EPA's Web site at *http://www.epa.gov/ttn/chief/pom.html*.

3.2 How Do I Identify Sources of Concern?

As a starting point, you should review the information in Appendices I and J. These include information relating HAPs to source categories regulated under the MACT standards program and vice versa. Reviewing these tables will provide a general understanding of which pollutants are likely to be emitted from which source categories. Other sources of information follow.

MACT Crosswalk

Another valuable resource for identifying sources of concern is the MACT Crosswalk, a database that matches SCCs to MACT source categories. MACT Crosswalk can be downloaded from the CHIEF's Web site at *http://www.epa.gov/ttn/chief/*.

NTI Databases

Other sources of information include state-specific NTI databases. These databases can be used to rank source categories included in the NTI by individual HAP emission levels and will provide an idea of what source categories contribute significantly to air pollution in your state. Alternatively, the state NTI databases can be used to rank HAP emissions and provide an idea of what HAPs are emitted in the largest quantities in your state. NTI data can be downloaded off the World Wide Web through EPA's Web site at *http://www.epa.gov/ttn/chief/*.

Other Information Sources

You should also consult the following information to identify specific facilities that may emit HAPs of concern:

- Existing state inventories of HAPs and criteria pollutants;
- TRI data for your state, *http://www.epa.gov/opptintr/tri/access.htm*;
- Existing registration program of major sources (through annual inventory submittal programs, permit renewal programs, RMP submittals, and/or upset and malfunction reports), though such programs usually do not include smaller significant point (nonmajor) sources or fugitive emissions;
- Source categories identified as part of EPA studies to execute various CAA-prescribed regulatory programs including Section 112(c)(6),

http://www.epa.gov/ttn/uatw/112c6/112c6fac.html, and Section 112(k), *http://www.epa.gov/ttn/uatw/112k/riuban.html*;

- State and local industrial directories;

- The *Dun and Bradstreet Million Dollar Directory* listing companies with sales over $1,000,000 per year by Standard Industrial Classification (SIC) code and county, *http://www.dnb.com*/; and

- Industries that are prevalent in the state (the agency may establish cutoff levels for toxics to exclude smaller sources from the inventory).

You should be cautious when using criteria pollutant inventories or existing registration programs as sources of information on facilities emitting HAPs. In general, you will be dealing with the same type of sources in both criteria and HAP inventories because most HAPs are a subset of either PM or VOC. However, not every source of HAP emissions will be included in the criteria pollutant inventory. Moreover, every source in the criteria pollutant inventory will not necessarily emit HAP emissions.

3.2.1 *How Do I Categorize Major Sources?*

Major sources are typically categorized into the following broad groups that account for a large proportion of HAP emissions:

- Stationary fuel combustion (boilers, internal combustion engines);

- Petroleum-related industries (oil and gas production, petroleum refineries, basic petrochemicals);

- Synthetic organic chemical manufacturing industry (SOCMI);

- Mineral products industry (processing and production of various nonmetallic minerals);

- Metal processing (mining, refining, production of metals);

- Inorganic chemical manufacturing industry (basic inorganic chemicals before they are used in the manufacture of other chemical products);

- Solvent use (surface coating, degreasing, fabric finishing, paint removal, polishing);

- Chemical products industry (carbon black, synthetic fibers, synthetic rubber, and plastics that may be used in further processing); and

- Wood products industry (conversion of logs to pulp, pulpboard, plywood, particleboard, or related wood products and wood preserving).

3.2.2 *How Do I Categorize Area Sources?*

Area sources are typically categorized into the following broad groups:

- Commercial and consumer organic solvent usage (surface coating, dry cleaning, degreasing, graphic arts, rubber, and plastics;

- Stationary fuel combustion (heating including waste oil combustion);

- Material storage and distribution;

- Waste treatment and disposal;

- Miscellaneous industrial manufacturing operations;

- Comfort and industrial cooling towers;

- Miscellaneous sources (forest fires and agricultural burning);

- Gasoline service stations; and

- Hospital and laboratory sterilizers.

3.3 What Data Do I Report?

Table 3-1 identified the list of HAPs identified as a priority list to be inventoried. Agencies having inventory data for any additional HAPs are encouraged to submit this information along with the data for the identified pollutants. Information in Appendix K may be modified by future guidance from EPA.

3.3.1 *Reporting Frequency*

Air pollution control agencies have the option of reporting emissions from one-third of their sources each year or reporting on all sources once every three years. Agencies and their respective EPA Regional Offices may tailor the reporting by selecting sources that most affect each agency. The list of facilities should be reexamined each year of the cycle. State agencies and their respective EPA Regional Offices should periodically examine the list of compounds

being reported to insure relevancy. States having legislatively mandated toxic data reporting schedules should contact their EPA Regional Office to reconcile any conflicting state and federal reporting requirements.

3.3.2 *Data Reporting Procedures*

Several options are available for reporting emissions data. Because electronic reporting technology is constantly changing, state and local agencies should contact their EPA Regional Office to obtain the acceptable reporting formats. Currently, you may choose to continue reporting to the EPA Aerometric Information Retrieval System (AIRS) using the AIRS Facility Subsystem (AFS) format for point sources. A second option is for the agency to use the NET database input format. The NET input format creates relational, normalized data sets which conform to the relational standards and structure of EPA's NET Oracle database. Information on the NET input format may be found at *www.epa.gov/oar/oaqps/efig/ei/*. For the latest information on data reporting procedures, call the Info CHIEF help desk at (919)541-5285.

3.3.3 *Data Elements To Be Reported*

Current lists of data elements to be reported for major and area sources of HAP emissions appear in Appendix K. Any data elements from these lists not reported will be generated by EPA using techniques at its disposal. The data elements to be reported may be modified over time and your agency should contact the EPA Regional Office for the most recent list of required data elements.

3.4 How Do I Assess the Completeness of the Inventory?

You can check for completeness by manually comparing your existing inventory with the MACT source categories and lists of HAPs shown in Appendices I and J. You can also check existing permit files for facilities by source category to ensure that all types of sources were included. The EIIP series of documents addresses completeness checks and should be consulted for more information.

3.5 What QA/QC Procedures Should I Follow?

You should include as part of the inventory work plan, a quality assurance plan (QAP). Issues to consider are:

- Quality control (QC) of calculations;
- Data verification procedures;
- Completeness checks;
- Consistency checks;

- Double counting;
- Reasonableness; and
- Data entry errors.

Inventory documentation ensures that the final written report or compilation of data accurately reflects the inventory effort. Accurate and complete documentation is necessary to determine quality of emissions estimates, identify the data references, and allow reproducibility of emissions estimates. Volume I of the EIIP series discusses typical documentation requirements for preparing an inventory report. Chapter 2 of Volume VI of the EIIP series discusses the need for comprehensive documentation and reporting from a QA program standpoint and provides example documentation.

3.6 How Do I Avoid Double Counting?

When an inventory contains major and area source contributions from the same process, it is possible that emissions could be double counted. The opportunity for this situation most frequently occurs when a top-down estimation method is used for the area source category. For example, emissions from large dry cleaning establishments (major sources) are included in an inventory. Emissions from small dry cleaners (below some specified cutoff) have been treated as an area source using a top-down approach. The area source inventory must be adjusted downward by subtracting the major source contributions to avoid double counting. Volume III of the EIIP series describes in detail how such adjustments can be made and provides a list of example sources that may share processes with point or major sources.

4.0 INVENTORY DEVELOPMENT

4.1 What Are the Main Approaches to Inventory Development?

There are two main approaches that your agency can follow in estimating HAP emissions: the top-down approach and the bottom-up approach.

Characteristics of a top-down approach are:
• National- or regional-level data are allocated to a state or county based on a surrogate parameter such as population or employment in a specific sector; • May be used when (1) local data are not available (2) the cost to gather local information is prohibitive or (3) the end use of the data does not justify the cost of collecting detailed site-specific data; • Typically used to inventory area sources; and • Requires minimum resources by making use of readily available and often published activity and emission data.

Characteristics of a bottom-up approach are:
• Requires more resources to collect site-specific information on emission sources, activity levels, and emission factors; • Typically used to inventory major sources; and • Results in more accurate estimates than a top-down approach.

4.2 What Are the Methods for Estimating Emissions?

As discussed in Section 2.1 of this document, an important consideration in planning the inventory is to determine how it will fit into your agency's overall air quality program. This anticipated use of the inventory will then dictate the level of complexity and accuracy required.

The main methods (both bottom-up and top-down approaches) currently used in estimating emissions of criteria pollutants can also be used to estimate emissions of air toxics. These methods include:

- Emission factors;

- Material balance (including fuel analysis);
- Source testing;
- Emission estimation models (usually software);
- Surveys and questionnaires; and
- Engineering judgment/best approximation.

It is important for you to select the estimation methods and approaches based on the best available data. This selection should be done for each source category and pollutant being inventoried. A bottom-up approach to emissions inventories is more accurate, yet more resource intensive than a top-down approach. However, in some situations, especially with area sources, a top-down approach may be the only option available to the inventory preparer. A top-down approach is particularly useful when national or regional estimates or emission factors are the only sources of information available on emissions from a specific source category. These estimates may be the result of large studies conducted by a consortium of states or by the U.S. EPA to fulfill a regulatory requirement or a CAA mandate. The state agency may choose to use the results of such studies in a top-down approach and allocate emissions to a smaller geographic area such as the state or a county. Three top-down methods can be used:

- Spatially allocating national- (or regional-) level emissions data to the state or county level using actual source activity data for the state or county being inventoried such as fuel usage;
- Apportioning national- (or regional-) level emissions to the state or county level using representative apportioning factors such as population or employment. In this case, the surrogate apportioning factor, a reasonable indicator of activity, takes the place of the actual activity level; or
- Applying a nationally (or regionally) derived emission factor to state- or county-level source activity data (or a representative surrogate, where applicable).

The use of these methods is best illustrated in the EIIP document series. EIIP promotes the development and use of standard procedures for collecting, calculating, storing, reporting, and sharing air emissions data. The EIIP manuals are a primary source of inventory guidance as it represents EPA's recognized standard for the development of reliable, quality rated inventories. The EIIP documents present preferred and alternative methods for estimating emissions from major (point), area, mobile, and biogenic source categories. EIIP also provides guidance on how to choose between preferred and alternative emission estimation methods based on accuracy. Appendix D of this handbook provides a listing of all of the published EIIP documents. Hard

copies of these manuals are available from the National Technical Information Service (NTIS). Electronic copies of the EIIP documents can be downloaded off the World Wide Web through the EIIP Web site at *http://www.epa.gov/oar/oaqps/eiip/*.

4.2.1 *Emission Factors*

Emission factors allow the development of generalized estimates of typical emissions from source categories or individual sources within a category. The calculation of area source emissions relies to a great extent on the use of emission factors because it is usually the most efficient approach to estimating emissions from these sources. Emission factors are also used extensively to estimate emissions from major and minor point sources.

Emission factors estimate the rate at which a pollutant is released to the atmosphere as a result of some process activity. While the emissions calculated using these values may differ from actual emissions for a specific facility, emission factors nevertheless provide a reasonable estimate of pollutant emissions across an entire source category.

EPA's Factor and Information Retrieval (FIRE) system, locating and estimating (L&E) document series, and AP-42 are the primary resources for emission factors. In addition to presenting emission factors, each information source gives a quality indicator for each factor.* The lower the quality indicator, the more likely that a given emission factor may not be representative of air pollutants emissions from the source type. The EPA continues to update these sources of information, where data are available. For a more detailed discussion on the limitations and/or uncertainties of using emission factors, please refer to the EIIP series, Volumes I, II, and III. Refer to Appendix D for a complete list of available EIIP documents.

To calculate emissions using emission factors, three basic inputs to the estimation algorithm are required:

- Activity information;
- An emission factor; and
- When applicable, information on capture and control efficiencies of any control device when using an "uncontrolled" emission factor.

The basic emission estimation equation when using an "uncontrolled" emission factor is:

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* Quality ratings (A through E and U) are assigned to emission factors based on the criteria for assigning data quality ratings and emission factor ratings as required in the document, *Technical Procedures for Preparing Emission Factor Documents*, EPA-454/R-95-015, revised 11/97.

$$E = R \times EF \times (1 - C/100)$$

where:

E	=	emission estimate for the process
R	=	activity level such as throughput
EF	=	emission factor assuming no control
C	=	capture efficiency x control efficiency (expressed in percent); C = O if no control device is in place

The basic emission estimation equation when using a "controlled" emission factor is:

$$E = R \times EF$$

where:

E	=	emission estimate for the process
R	=	activity level such as throughput
EF	=	"controlled" emission factor

Area sources sometimes are not easily estimated by a direct measure of activity. In such a case, an emission factor that is based on a surrogate measure for activity level such as population or employment in an industry will need to be devised. Appendix L includes numerical examples illustrating the use of emission factors for estimating HAP emissions from stationary sources.

4.2.2 *Material Balance*

When using a material balance method, emissions are determined by knowing the amount of a certain material that enters a process, the amount that leaves the process by all routes, and the amount shipped as part of the product itself. This technique is equally applicable to both major and area sources. Material balance is particularly useful for sources resulting in evaporative losses. Typical processes for which a material balance is particularly useful are solvent degreasing operations and surface coating operations. Material balance should not be used for processes where material reacts to form secondary products or where the material otherwise undergoes significant chemical changes.

The basic emission estimation equation for mass balance is:

$$E_x = (Q_{in} - Q_{out}) * C_x$$

where:

E_x	=	total emissions for pollutant x

Q_{in} = quantity of material entering the process
Q_{out} = quantity of material leaving the process as waste, recovered, or in product
C_x = concentration of pollutant x in the material.

The term Q_{out} could involve several different "fates" for an individual pollutant. This could include the amount recovered (or recycled) or the amount leaving the process in the product or waste stream.

Appendix L includes numerical examples illustrating the use of material balance for estimating HAP emissions from stationary sources.

4.2.3 *Source Testing*

Results of source testing conducted by either a state or local agency or by the source itself can be used for estimating air toxic emissions. Although source testing generally yields more accurate emission estimates than emission factors or material balance, its use in air toxics emissions inventories may be limited for several reasons. First, source testing can be expensive, especially if the cost is compounded by a large number of toxic pollutants to be tested. Second, source testing provides a "snapshot" of emissions from a process. As a result, uncertainties in source testing emission estimates arise because the process conditions may change over time while the test results can only reflect the emission rate and conditions during the test runs. Finally, standardized source testing reference methods have not been developed for all air toxics. Appendix L includes numerical examples illustrating the use of source testing data for estimating HAP emissions from stationary sources.

EPA has developed reference methods for measuring HAP emissions. Available resources on methods for measuring HAP emissions include:

- Appendix B of the *Code of Federal Regulations Title 40 Part 6;* and

- EPA's publication *Screening Methods for the Development of Air Toxics Emission Factors* which presents an overview of the use of these reference methods for specific HAPs (EPA, September 1991). The purpose of this document is to identify methods with the broadest possible applicability to the 188 HAPs listed in the CAA. Methods developed for the sampling and analysis of ambient air samples may also be applicable to source testing with some modification. If ambient methodology is applied, care must be taken to ensure that the capacity of the method is not exceeded so that results will be quantitative (e.g., avoid saturation; typical ambient air concentration levels are much lower than stationary source concentration levels). Appendix M includes a list of applicable sampling methods from that document.

Source test data are of great value for obtaining general information on the characteristics of a particular industry and for obtaining specific information on pollutants being emitted and control device operational parameters. The raw data contained in source test reports can be used to develop emission factors for each pollutant and emission source of interest. Although sources are site-specific, these data can be extrapolated to apply to other representative emission sources for purposes of calculating emissions. The Emission Measurement Technical Information Center (EMTIC) provides technical guidance on stationary source emission testing. EMTIC can be accessed on the World Wide Web at *http://ttnwww.rtpnc.epa.gov/html/emtic/emtic.htm#EM02.*

4.2.4 *Emission Estimation Models*

Some emission estimation models currently available are based on measured or empirical values. Emission estimation software is used when a large number of equations and interactions must be manipulated and the effect of many different parameters must be accounted for in order to estimate emissions. The most widely used emission estimation models are listed below and described in detail in Appendix N:

- The Landfill Air Emissions Estimation Model (LAEEM) *http://www.epa.gov/ttn/catc/products.html#software*

- TANKS to estimate emissions from fixed- and floating-roof storage tanks *http://www.epa.gov/ttn/chief/tanks.html*

- WATER8 and CHEMDAT8 to estimate air emissions from wastewater collection and treatment systems *http://www.epa.gov/ttn/chief/software.html#water8*

- CINCI (EPA-Cincinnati) for predicting the fate of organics in wastewater treatment plants.

Additional emission estimation models are described in the various chapters of the EIIP series. Specifically, Chapter 5 of Volume II of the EIIP series describes additional models for estimating air emissions from wastewater collection and treatment systems. Chapter 10 of Volume II describes programs available for estimating emissions from oil and gas field processing operations.

NOTE: If you choose to use a non-EPA model to estimate emissions, you should do a thorough evaluation of that model/software and you should get prior approval from your EPA Regional Office.

4.2.5 *Surveys and Questionnaires*

Some state agencies use surveys for locating air toxics sources and estimating emissions. The scope of the survey must be determined during the planning phase of the inventory. For

example, a detailed survey may target all facilities within a specific source category or may list specific toxic pollutants. This approach would reduce the number of sources contacted and improve the quality of the data collected because the survey questionnaire is tailored to specific types of sources with similar processes. Alternatively, the survey may not target specific sources nor limit the pollutants inventoried. This approach will require a more generic design of the survey questionnaire and consequently may result in less detailed and possibly less accurate data. In either case, you should determine early on whether your agency has the staff and resources to design, mail, process, administer, and analyze the results of a survey.

Appendix O provides guidance for state and local air pollution agencies that wish to develop or expand their air toxics emission inventories using surveys. Volume III of the EIIP document series details the circumstances under which a survey or questionnaire is most appropriate as an emission estimation tool.

4.2.6 *Engineering Judgment/Best Approximation*

"Engineering judgment" or "best approximation" must be considered as a last resort if none of the methods described above can be used to generate accurate emission estimates. Engineering judgment may involve the application of speculative or innovative ideas, a poorly documented emission factor, or a crude material balance. In cases where no emission factors are available but adverse risk is low, it may be acceptable to apply factors from a similar source category using engineering judgment.

4.3 How Do I Select Which Method To Use for Estimating Emissions?

Selecting a method to estimate source specific emissions warrants a case-by-case analysis considering the cost and risk in the specific situation. Selection of a method is a function of several issues that one should consider when analyzing the tradeoffs between cost and accuracy of the resulting estimates. These issues include:

- Availability of quality data needed for developing emissions estimates;
- Practicality of the method for the specific source category;
- Intended end use of the inventory (e.g., an inventory of significant regulatory implications such as residual risk or environmental justice inventories may require more accurate and costly emission estimation methods than an inventory intended to provide a general source characterization);
- Source category priority (e.g., if a source category is of relatively high priority, it may require a more accurate emission estimation method; however, the resources available to the agency to perform the inventory may dictate a less accurate and less costly methodology);

- Time available to prepare the inventory; and

- Resources available in terms of staff and funding.

To help you decide which estimation methods to use, you should refer to the EIIP series of documents. The EIIP consists of several committees whose mandate is to develop concise, accurate, and innovative emission inventory development guidance. An important aspect of the EIIP's selection of methods was the identification of "preferred" and "alternative" methods. Refer to Volume I, *Introduction to the Emission Inventory Improvement Program*, for a complete discussion on how to select emission estimation methods. Appendix D provides a complete list of available EIIP documents and Appendix L presents example calculations based on EIIP preferred method recommendations.

4.4 What Emission Databases Are Available?

The most current and accessible emission databases available for review and assessment in developing an air toxics inventory include:

- Aerometric Information Retrieval System (AIRS) [1 (800) 334-2405 or (919) 541-7862];

- AIRSWeb, *http://www.epa.gov/airsweb/sources.htm*;

- The National Toxics Inventory, *http://www.epa.gov/ttn/chief*;

- The Toxic Release Inventory, *http://www.epa.gov/opptintr/tri/access.htm*; and

- The National Emissions Trend (NET) Database, *FTP://www.epa.gov/pub/EmisInventory*.

Detailed descriptions of these databases are provided in Appendix F.

4.5 Where Do I Find Emission Factor Information?

There are four main types of resources that can be used to locate emission factors, each of which is described in the following section:

- Emission factor documents;

- Emission factor databases;

- Existing source testing data; and

- Material Safety Data Sheets (MSDSs) or Certified Product Data Sheets (CPDSs).

4.5.1 *Emission Factor Documents*

Emission factors have long been used as a cost-effective means to develop emission inventories. Air toxic emission factors can be applied to activity levels to estimate emissions. The primary references for air toxic emission factor data are:

- *Locating and Estimating Air Emissions from Sources of (Source Category) or (Substance) Documents*—a complete list of L&E documents is included in Appendix P, *http://www.epa.gov/ttn/chief/ap42etc.html#LE*; and

- *Compilation of Air Pollutant Emission Factors (AP-42)* (EPA, 1996) *http://www.epa.gov/ttn/chief/ap42etc.html*.

These resources are discussed in detail in Appendix N. Some sources of information on emission factors give quality ratings for the reported factors.* As an emissions inventory preparer, you should take into consideration the accuracy, derivation, and appropriateness of the emission factors being employed so that gross errors in emission estimates can be avoided.

A search of technical papers for source test and background information should also be conducted for the emission source category or pollutants in question. This search can be conducted by EPA library services or through government document depositories at local universities. Examples of references and documents that should be reviewed include:

- EPA reports presenting the results of engineering investigations of air emissions from various industrial processes such as Control Techniques Guidelines (CTGs) and Available Control Techniques (ACT) documents, and Background Information Documents (BIDs) for New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP) or Maximum Achievable Control Technology (MACT) standards. These reports are available through the Government Printing Office (GPO), the National Technical Information Service (NTIS), and on the World Wide Web at *http://www.epa.gov/ttn/*;

- Reports prepared for the compilation of air toxics emission inventories in support of CAA-mandated studies under Section 112(c)(6) or Section 112(k). These reports provide information on approaches to estimating certain air toxics

* Quality ratings (A through E and U) are assigned to emission factors based on the criteria for assigning data quality ratings and emission factor ratings as required in the document, *Technical Procedures for Preparing Emission Factor Documents*, EPA-454/R-95-015, revised 11/97.

emissions. The Section 112(c)(6) report can be downloaded from the UATW at *http://www.epa.gov/ttn/uatw/112c6/112c6fac.html*. The Section 112(k) report, in external draft form, is also available on the UATW at *http://www.epa.gov/ttn/uatw/112k/riurban.html*;

- Miscellaneous private sector resources. For example, the National Council of the Paper Industry for Air and Stream Improvements compiles, through a highly focused research program, reliable environmental data and information on the forest products industry.

- Emission factor reports published by other state and local agencies, and other states' databases and source tests. This information can be identified and acquired through direct communication with the agencies. It is vitally important that you maintain communications with other state agencies (i.e, CARB, GLC) in order to share useful information and insight to air toxics issues.

4.5.2 *Emission Factor Databases*

Several emission factor databases are currently available in easy-to-access formats to state and local agencies. Some of these tools include:

- Factor Information Retrieval (FIRE) Data System (EPA, May 1998), *http://www.epa.gov/ttn/chief/fire.html* or (919) 541-5285; May 1998

- Air Clearinghouse for Inventories and Emission Factors (Air CHIEF) CD-ROM, *http://www.epa.gov/ttn/chief/airchief.html#order* or (202) 512-1800; and

- Unified Air Toxics Web site (UATW), *http://www.epa.gov/ttn/uatw/*.

Each of these resources is described in detail in Appendix N.

4.5.3 *Existing Source Testing Data*

Source testing data used for compliance purposes and in developing operating permits for stationary sources may be readily available through state and local air permitting agencies. The use of source test data reduces the number of assumptions regarding the applicability of emission factors to a source, since emission factors are often developed based on source testing that may not exactly represent the operational scenarios at all facilities.

4.5.4 *MSDSs and CPDSs*

Speciation factors or speciation profiles that are specific to a certain facility or source category can be directly applied to emissions of VOCs and particulate matter (PM). When applied to

VOC emissions, speciation factors yield estimates of low molecular weight organic compounds. When applied to PM emissions, speciation factors yield estimates of high molecular weight organic and toxic metal compounds.

The MSDS and CPDS are sources of speciation profiles. Each MSDS and CPDS lists specific compounds and weight percentages of hazardous ingredients present in a certain material. The MSDS and CPDS are especially important when using material balances as an air toxic emissions estimation tool. The MSDS and CPDS are easy to obtain as a result of state and federal right-to-know laws that require that information be made available on the composition of products being used in the work place. However, an MSDS may be of limited accuracy in estimating HAP emissions because MSDS documentation is required primarily to provide information on occupational safety. In addition, only components in excess of certain established concentrations are subject to MSDS reporting. Moreover, an MSDS often reports a range for pollutant concentrations and sometimes the concentration may not be reported at all in order to protect trade secrets.

4.6 Where Do I Find Applicable Activity Parameters?

Activities used to calculate major and area source emissions for the same category are not necessarily the same. Major sources may require direct measurement or direct activity (i.e., throughput) applied to an emission factor, while emissions from area sources are often estimated using surrogate activity factors, such as population.

For major sources, activity parameters are generally reported as fuel consumption rates or process weight rates for fuel-burning equipment and industrial processes, respectively. Detailed data on process equipment, throughput, capacity, and other parameters are needed to estimate emissions from major sources.

Traditional sources of activity data for major sources include:
• Agency permitting and source registration programs;
• Agency-sponsored surveys and questionnaires sent to industrial sources;
• State and local industrial directories;
• State Departments of Commerce and Labor statistics
• National and state directories of manufacturers;
• Data compiled by private research and development companies such as the *Directory of Chemical Procedures* compiled by SRI International; and

Traditional sources of activity data for major sources include (Continued):
• Trade and professional associations.

Area source emission estimates are generally based on a surrogate activity parameter and an emission factor developed specifically for that activity parameter. Activity parameters typically include population, employment, production, land use, and other parameters that can be correlated with air emissions. Traditionally, area source activity factors have been developed in a top-down manner by extrapolating national data down to the state or county level.

Traditional sources of activity data for area sources include:
• U.S. Department of Commerce publications including *County Business Patterns, Census of Population, Census of Manufacturers, Census of Agriculture, County and City Data Book, Current Industrial Reports, Annual Housing Survey,* and *Census of Retail Trade;*
• Regional planning commissions;
• Agency-sponsored surveys;
• U.S. Department of Energy publications such as *State Energy Data Reports, Natural Gas Annual,* and *Petroleum Marketing Annual;*
• State Departments of Transportation and State Energy Offices (for information on gasoline consumption and paving activities);
• State Departments of Labor (for employment data by SIC code)
• State Agricultural Offices and U.S. Department of Agricultural (for pesticide application data);
• State Solid Waste Management Agencies;
• Fire marshals (for information on structural fires);
• Port authorities and waterborne commerce (for information on petroleum vessels loading and unloading activities); and
• State Health Departments (for information on hospital sterilizers); and
• Miscellaneous statistical government and trade group publications.

Collectively, these references will provide much of the basic activity data necessary for compiling the emissions inventory.

4.7 What Special Issues Should I Consider When Estimating Stationary Source Toxic Emissions?

- Consider what source categories to include in the inventory: Attempting to inventory all toxic pollutants may overburden an agency's resources, especially if a majority of the compounds are not emitted at levels deemed significant by the state. A screening study will help your agency focus its inventory effort. Guidance on how to conduct screening studies for the purpose of air toxics inventories is available in the EPA document *Compiling Air Toxics Emission Inventories* and in Appendix O.

- Consider what levels of HAP emissions to include in the inventory: If the agency does not preclude reporting of emissions below specific exemption or de minimis levels, the effect on agency resources may be similar to that of inventorying all source categories of toxic pollutants.

- Consider HAP synonyms: Sources may report trade names or chemical synonyms that the agency may have difficulty in interpreting. This can be avoided to a great extent if the agency uses Chemical Abstract Services (CAS) Registry numbers in requesting air toxics-related data from the sources.

- Consider the differences in the major and area source definition(s) for the purposes of criteria and HAP inventories: When using the criteria pollutant inventory as a starting point for the air toxics inventory, the agency must evaluate the major and area source distinctions very carefully. Some industrial sources with PM or VOC emissions below typical cutoff levels may be categorized as area sources for the purpose of a criteria pollutant's inventory, but may qualify as major sources for the purpose of a HAP inventory.

- Check the results of any survey for completeness: When surveying sources directly, there may be a need to follow-up with a facility, particularly if the agency believes it is emitting a certain pollutant it does not report.

- Stay informed of air toxics rules and rule development activities and implementation information: Comprehensive MACT rule-specific information including *Federal Register* publications and citations, compliance dates, and MACT rule contact names and phone numbers can be accessed through the UATW site at *http://www.epa.gov/ttn/uatw/eparules.html*.

- Consider HAP emissions control devices when such devices are in place: The Hazardous Air Pollutant Program (HAP-PRO) is a computer software program used to assist permit engineers in reviewing applications for control of air toxics. A secondary purpose of HAP-PRO is to generate reports that list all facilities containing (1) a specified pollutant in their emission stream(s), or (2) a specified type of emission stream (e.g., organic vapors). HAP-PRO is available on the World Wide Web at *http://www.epa.gov/ttncatc1/products.html*.

- Nationally-derived emission factors may not apply directly to your area and may need to be adjusted: When the information used to develop an emission factor is based on national data, such as a wide range of source tests or national consumption estimates, you should be particularly careful with potential local variations. Emissions calculated using national emission factors may vary considerably from actual values at a specific source or within a specific geographic area.

- Avoid double counting of sources and emissions: while some sources of emissions are strictly categorized as area sources such as structural fires, cutback asphalt, and traffic marking, many major source categories have area source components such as solvent usage and graphic arts. Where area source emissions for a category with a major source component are calculated using a surrogate activity factor such as employment, the employment at the major sources should be subtracted from the inventory region employment to yield the area source employment. However, this approach may not always be a straight forward calculation and would require that emission estimates be adjusted in cases where employment figures for the major sources are higher than those for the inventory region.

5.0 EMISSIONS INVENTORY MAINTENANCE AND UPDATE

Compiling an air toxics emissions inventory is a continuous process. Maintaining and updating the inventory will ensure its usefulness beyond the year it was first developed. Updating the inventory is necessary because over time some facilities retire process equipment or shut down, and new plants or new processes at existing plants will come online. In addition, facilities may change their production schedules or modify their product lines. Demographics and land use changes may also affect air toxics emissions from area sources. Other factors that may have an impact on air toxic emissions include new regulations, new emission factors and new scientific discoveries.

To maintain accurate emission inventories, complete and concise documentation and QA procedures must be implemented as well as good data management practices. Volume VI of the EIIP document series addresses all of these topics in detail.

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7.0 DEFINITIONS OF COMMONLY USED TERMS

Accuracy is (1) the closeness of a measurement to its true value, or (2) the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.

Activity Level/Factor is a measurable factor that is directly or indirectly related to the emissions of a process. An emission estimate is calculated by multiplying an activity level by an emission factor. The activity level is either directly related to the amount of emissions (as in the case of the amount of fuel used in a combustion process), or is a more easily measured surrogate, such as population for consumer product usage.

Actual Emissions are the actual rate of emissions of a pollutant from an emissions unit calculated using the unit's actual operating hours, production rates, and types of materials processed, stored, or combusted during the selected time period.

Allowable Emissions are the emissions rate that represents a limit on the emissions that can occur from an emissions unit. This limit may be based on a federal, state, or local regulatory emission limit determined from state or local regulations and/or 40 Code of Federal Regulations (CFR) Parts 60, 61, and 63.

Ambient Standards limit the concentration of a given pollutant in the ambient air. Ambient standards are not emissions limitations on sources, but usually result in such limits being placed on source operation as part of a control strategy to achieve or maintain an ambient standard.

Area Sources are smaller sources that do not qualify as major sources under the relevant emissions cutoffs. Area sources encompass more widespread sources that may be numerous, but that, individually, release small amounts of a given pollutant. These are sources for which emissions are estimated as a group rather than individually. Examples typically include dry cleaners, residential wood heating, auto body painting, and consumer solvent use. Area sources generally are not required to submit individual emissions estimates. Section 112(a) of the CAA defines "area source" as any stationary source of HAPs that does not qualify as a major source.

Attainment Area is an area considered to have air quality as good as or better than the National Ambient Air Quality Standards (NAAQS) as defined in the CAA. Note that an area may be in attainment for one or more pollutants but be a nonattainment area for one or more other pollutants.

Audit of Data Quality means a qualitative and quantitative audit in which data and data handling are reviewed and data quality is assessed.

Audits are systematic evaluations to determine the quality of a function or activity.

Average means the sum of all the items or observations in a sample divided by the number of items in the sample. Synonymous with "sample mean."

Continuous Emissions Monitoring is any monitoring effort that "continuously" measures (i.e., measures with very short averaging times) and records emissions. In addition to measuring and recording actual emissions during the time of monitor operation, continuous emissions monitoring data can be used to estimate emissions for different operating periods and longer averaging times.

Control Efficiency is the emission reduction efficiency, and is a percentage value representing the amount of a source category's emissions that are controlled by a control device, process change, or reformulation.

Criteria Pollutant refers to a pollutant for which a NAAQS has been set. Criteria pollutants are carbon monoxide, lead, nitrogen oxides, ozone, particulate matter within aerodynamic diameter less than or equal to 10 micrometers, and sulfur oxides.

Data Attribute Rating System is a semiquantitative system developed by the U.S. EPA to evaluate emissions uncertainty by assigning numerical values to the perceived quality of the emission factors and activity data.

Data Management Plan is a written document prepared prior to inventory development that may be a part of the QA plan. It describes the required inventory development records, the steps required to produce them, how the records are to be stored, the retention period, the procedures for retrieving them, and the circumstances for their destruction.

Data Quality Indicators are qualitative and quantitative descriptors used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are accuracy, comparability, completeness, and representativeness.

Double Counting means estimation and counting of estimated emissions twice in an inventory for the same source category. Area source inventories are at risk of double counting emissions from two sources because of major and area source overlap and overlap between two area sources.

Emission means pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, aircraft, or other nonroad engines.

Emission Factors are ratios that relate emissions of a pollutant to an activity level that can be easily measured, such as an amount of material processed or an amount of fuel used. Given an

emission factor and a known activity level, a simple multiplication yields an estimate of the emissions. Emission factors are developed from separate facilities within an industry category, so they represent typical values for an industry, but do not necessarily represent a specific source.

Emission Inventory is a listing, by source, of the amount of air pollutants discharged into the atmosphere of a community.

Emission Standards are a general type of standard that limit the mass of a pollutant that may be emitted by a source. The most straightforward emissions standard is a simple limitation on mass of pollutant per unit time (e.g., pounds of pollutant per hour).

Engineering Estimate is a term commonly applied to the best approximation that can be made when the specific emission estimation techniques such as stack testing, material balance, or emission factor are not possible. This estimation is usually made by engineers familiar with the specific process, and is based on whatever knowledge they have.

Equivalent Method means any method of sampling and analyzing for air pollution that has been demonstrated to the U.S. EPA Administrator's satisfaction to be, under specific conditions, an acceptable alternative to normally used reference methods.

Fugitive Emissions are emissions from sources that are technically infeasible to collect and control (storage piles, wastewater retention ponds, etc.).

Growth Factors are surrogate indicators based on economic or demographic parameters that predict the proportional change in the activity level or emissions for a particular emissions source.

Hazardous Air Pollutants (HAPs) are listed in Section 112(b) of the 1990 Clean Air Act Amendments (CAAA). The CAAA specifies a list of 189 HAPs to be subject to regulation. The list of HAPs includes relatively common pollutants such as formaldehyde, chlorine, methanol, and asbestos, as well as numerous less common substances. Pollutants may, under certain circumstances, be added to or deleted from the list. To date, one pollutant has been deleted from the list, resulting in 188 HAPs.

Inventory Area is generally defined by political boundaries such as county or state boundaries, where the jurisdictions that are included in an inventory area make up an air basin or experience common air problems. The pollutant or the type of air pollution inventory will determine the exact geographic area that will be covered.

Inventory Work Plan is a document that discusses staff assignments and responsibilities, establishes a commitment to the inventory development and QA/QC processes, and establishes a commitment to personnel training and project documentation requirements. It may either be integrated with the quality assurance plan or a separate document.

Major Source is a term that is defined in the CAA and used in HAP inventories. Section 112(a) of the CAA defines "major source" as any stationary source (including all emission points and units located within a contiguous area and under common control) of air pollution that has the potential to emit, considering controls, 10 tons or more per year of any one HAP or 25 tons or more per year of any combination of HAPs.

Material Balance *or* ***Mass Balance*** is a method for estimating emissions that attempts to account for all the inputs and outputs of a given pollutant. If inputs of a material to a given process are known and all outputs except for air emissions can be reasonably well quantified, then the remainder can be assumed to be an estimate of the amount lost to the atmosphere for the process.

Mathematical Emission Model is an emission estimation technique that uses a mathematical model to estimate emissions. A very simple mathematical model multiplies an emission factor and an activity level to produce an emission estimate. A more complex model may involve multiple parameters and iterations in the calculation process. A mathematical model may be used by inventory preparers as an equation or as a computer program.

Maximum Achievable Control Technology (MACT) Standards are emissions limitations developed under Section 112(d) of the CAAA National Emissions Standards for Hazardous Air Pollutants (NESHAP). The limitations are based on the best demonstrated control technology or practices in similar sources to be applied to major sources emitting one or more of the listed HAPs.

Mean is synonymous with "average." Also called "arithmetic mean."

National Ambient Air Quality Standards (NAAQS) are the main ambient standards for the following six criteria pollutants: carbon monoxide, lead, nitrogen oxides, ozone, particulate matter within aerodynamic diameter less than or equal to 10 micrometers, and sulfur oxides.

National Emissions Standards for Hazardous Air Pollutants (NESHAP) are a class of standards limiting emissions of HAPs. The NESHAPs are published in 40 CFR Parts 61 and 63.

New Source Performance Standards (NSPS) are promulgated for criteria, hazardous, and other pollutant emissions from new, modified, or reconstructed sources that the U.S. EPA determines contribute significantly to air pollution. These are typically emission standards, but may be expressed in other forms such as concentration and opacity. The NSPS are published in 40 CFR Part 60.

Particulate Matter within aerodynamic diameter less than or equal to 10 micrometers is a measure of small solid matter suspended in the atmosphere. Small particles can penetrate deeply into the lung where they can cause respiratory problems. Emissions of PM_{10} are significant from

fugitive dust, power plants, commercial boilers, metallurgical industries, mineral industries, forest and residential fires, and motor vehicles.

Plant-level Reporting is generally required if total emissions from a plant (which may be composed of numerous individual emission points) meet the point source cutoff. These data can be used by a state to conduct a detailed estimate of emissions from that plant. The plant-level reporting used by most air pollution control agencies generally requires that the facility provide data that apply to the facility as a whole. Such data include the number of employees and the Standard Industrial Classification (SIC) code designation for the plant. A plant usually has only one SIC code denoting the principal economic activity of the facility. For the purpose of clearly identifying and tracking emissions data, each plant is generally assigned a plant (alternatively, "facility") name and number. The plant is also identified by geographic or jurisdictional descriptors such as air quality control region, county, address, and Universal Transverse Mercator (UTM) grid coordinates (or latitude/longitude) that identify a coterminous location. An owner or operator engaged in one or more related activities is also identified. In some cases, plantwide emissions may be reported at the plant level.

Plant-level Emissions are consolidated for an entire plant or facility. A plant may contain one or many pollutant-emitting sources.

Point-level Emissions typically represent single stacks or vents individually large enough to be considered point sources.

Point-level Reporting includes specific data for individual emission points (typically stacks). These data are more detailed than that submitted in plant-level reporting and may include emission-related and modeling information such as stack height of the release point, diameter of the stack, emission rate, method of determination, fugitive emissions, gas exit velocity from a stack, gas temperature, and operating schedule. Source identification information, as described under plant-level reporting, is usually also required at the point level to ensure that emission data for a single plant remain clearly identified. Regulatory agencies generally maintain individual emission-related records at the point level.

Point Sources is a term often used in a criteria pollutant inventory. Point sources are large, stationary, identifiable sources of emissions that release pollutants into the atmosphere. Sources are often defined by state or local air regulatory agencies as point sources when they annually emit more than a specified amount of a given pollutant, and how state and local agencies define point sources can vary. Point sources are typically large manufacturing or production plants. They typically include both confined "stack" emission points as well as individual unconfined "fugitive" emission sources.

Potential Emissions are the potential rate of emissions of a pollutant from an emissions unit calculated using the unit's maximum design capacity. Potential emissions are a function of the unit's physical size and operational capabilities.

Quality is the sum of features and properties/characteristics of a product or service that bear on its ability to satisfy stated needs.

Quality Assurance (QA) is a planned system of activities designed to provide assurance that the quality control program is actually effective. QA is a process that involves both the inventory team and external reviewers to insure the overall quality of the inventory.

Quality Assurance Plan (QAP) is a formal document describing the management policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an agency or company for ensuring quality in its products and usefulness to its users.

Quality Control (QC) comprises the activities undertaken by all members of the inventory team during the inventory preparation that will result in the correction of specific problems such as mistaken assumptions, lost or uncollected data, and calculation and data entry errors.

Reported Emissions are those emission estimates that are submitted to a regulatory agency. Emissions inventories can be used for a variety of purposes such as State Implementation Plan (SIP) base year inventories, environmental compliance audits, air quality rule applicability, and reporting information in an air quality permit application. Emissions can be reported on an actual, potential, or maximum basis. Many state and local air pollution control agencies have rules and regulations that define an allowable emission value for a particular piece of equipment. Because of this, a facility should first define the purpose of the inventory and then choose the appropriate means of reporting emissions to the regulatory agency. For example, SIP base year inventories for point sources would contain actual emissions. However, regulatory applicability and air quality permit applications can require that actual, allowable, and potential emissions be reported.

Source Classification Codes (SCCs) are codes defined by EPA that classify air emission sources by individual processes and/or operations. SCCs vary in the amount of detail. For some sources, there are SCCs for individual release points within the process. In other cases, an entire process may be represented by a single SCC.

Source Tests are short-term tests used to collect emissions data that can then be extrapolated to estimate long-term emissions from the same or similar sources. Uncertainties arise when source test results are used to estimate emissions under process conditions that differ from those under which the test was performed.

Spatial Allocation entails assignment of activity levels or emission estimates to a smaller or larger geographic area than the area for which the activity level or emission estimate was prepared. Allocation usually requires the identification of a surrogate indicator that can be used for scaling.

Standard Industrial Classification (SIC) Codes are codes defined by the U.S. Department of Commerce that classify businesses by products or services. SICs are the federal standard for classifying establishment-based statistics. SIC codes are being replaced by the North American Industry Classification System (NAICS), a system developed jointly by the U.S., Canada, and Mexico to provide new comparability in statistics about business activity across North America. The U.S. NAICS Manual is available on the World Wide Web at *www.census.gov/epcd/www.naic.html*.

State Implementation Plan (SIP) is a state plan approved by EPA for the establishment, regulation, and enforcement of air pollution standards.

Stationary Source is a fixed-site producer of pollution, including power plants and other major sources such as industrial manufacturing facilities as well as area sources.

Surveys are a method to collect inventory data using telephone or written questionnaires that are answered by manufacturers or suppliers of products, or by representatives at the facilities or sites where the emitting processes take place. An area source survey may also include review and data collection from existing air pollution permits within an agency. Surveys for area source inventories usually survey a subset of the population of sources.

Total Quality Management is a system of activities designed to provide continuous improvement at every level and in all areas of responsibility.

Variable is an entity subject to variation or change.

Volatile Organic Compounds (VOC) means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. This includes any such organic compound other than the following, which have been determined to have negligible photochemical reactivity:

- Methane
- Ethane
- Methylene chloride (dichloromethane)
- 1,1,1-trichloroethane (methyl chloroform)
- 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113)
- Trichlorofluoromethane (CFC-11)
- Dichlorodifluoromethane (CFC-12)

- Chlorodifluoromethane (HCFC-22)
- Trifluoromethane (HFC-23)
- 1,2-dichloro-1,1,2,2-tetrafluoroethane (CFC-114)
- Chloropentafluoroethane (CFC-115)
- 1,1,1-trifluoro-2,2-dichloroethane (HCFC-123)
- 1,1,1,2-tetrafluoroethane (HFC-134a)
- 1,1-dichloro-1-fluoroethane (HCFC-141b)
- 1-chloro-1,1-difluoroethane (HCFC-142b)
- 2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124)
- Pentafluoroethane (HFC-125)
- 1,1,2,2-tetrafluoroethane (HFC-134)
- 1,1,1-trifluoroethane (HFC-143a)
- 1,1-difluoroethane (HFC-152a)
- Parachlorobenzotrifluoride (PCBTF)
- Cyclic, branched, or linear completely methylated siloxanes
- Acetone
- Perchloroethylene (tetrachloroethylene)
- 3,3-dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca)
- 1,3-dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)
- 1,1,1,2,3,4,4,5,5,5-decafluoropentane (HFC 43-10mee)
- Difluoromethane (HFC-32)
- Ethylfluoride (HFC-161)
- 1,1,1,3,3,3-hexafluoropropane (HFC-236fa)
- 1,1,2,2,3-pentafluoropropane (HFC-245ca)
- 1,1,2,3,3-pentafluoropropane (HFC-245ea)
- 1,1,1,2,3-pentafluoropropane (HFC-245eb)
- 1,1,1,3,3-pentafluoropropane (HFC-245fa)
- 1,1,1,2,3,3-hexafluoropropane (HFC-236ea)
- 1,1,1,3,3-pentafluorobutane (HFC-365mfc)
- Chlorofluoromethane (HCF-31)
- 1-chloro-1-fluoroethane (HCFC-151a)
- 1,2-dichloro-1,1,2-trifluoroethane (HCFC-123a)
- 1,1,1,2,2,3,3,4,4-nonafluoro-4-methoxy-butane ($C_4F_9OCH_3$)
- 2-(difluoromethoxymethyl)-1,1,1,2,3,3,3-heptafluoropropane ($(CF_3)_2CFCF_2OCH_3$)
- 1-ethoxy-1,1,2,2,3,3,4,4, 4-nonafluorobutane ($C_4F_9OC_2H_5$)
- 2-(ethoxydifluoromethyl)-1,1,1,2,3,3,3-heptafluoropropane ($(CF_3)_2CFCF_2OC_2H_5$)
- Methyl acetate and perfluorocarbon compounds which fall into these classes:
  - (i) Cylic, branched, or linear, completely fluorinated alkanes
  - (ii) Cylic, branched, or linear, completely fluorinated ethers with no unsaturations
  - (iii) Cylic, branched, or linear, completely fluorinated tertiary amines with no unsaturations and
  - (iv) Sulfur containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine.

APPENDIX A

LIST OF HAZARDOUS AIR POLLUTANTS

BY CAS NUMBER

List of Hazardous Air Pollutants By CAS Number

CAS Number*	HAP Name
N/A	Antimony Compounds
N/A	Arsenic Compounds(inorganic including arsine)
N/A	Beryllium Compounds
N/A	Cadmium Compounds
N/A	Chromium Compounds
N/A	Cobalt Compounds
N/A	Coke Oven Emissions
N/A	Cyanide Compounds
N/A	Fine Mineral Fibers
N/A	Glycol ethers
N/A	Lead Compounds
N/A	Manganese Compounds
N/A	Mercury Compounds
N/A	Nickel Compounds
N/A	Phosphorous Compounds
N/A	Polycyclic Organic Matter
N/A	Radionuclides (including radon)
N/A	Selenium Compounds
50000	Formaldehyde
51285	2,4-Dinitrophenol
51796	Ethyl carbamate (Urethane)
53963	2-Acetylaminofluorene
56235	Carbon tetrachloride
56382	Parathion
57147	1,1-Dimethyl hydrazine
57578	Beta-propiolactone
57749	Chlordane
58899	Lindane (all isomers)
59892	N-Nitrosomorpholine
60117	Dimethyl aminoazobenzene
60344	Methylhydrazine
60355	Acetamide
62533	Aniline
62737	Dichlorvos
62759	N-Nitrosodimethylamine
63252	Carbaryl
64675	Diethyl sulfate
67561	Methanol
67663	Chloroform
67721	Hexachloroethane
68122	Dimethyl formamide
71432	Benzene (including benzene from gasoline)
71556	Methyl chloroform (1,1,1-Trichloroethane)
72435	Methoxychlor
72559	DDE (1,1-dichloro-2,2-bis(p- chlorophenyl) ethylene)
74839	Methyl bromide (Bromomethane)
74873	Methyl chloride (Chloromethane)
74884	Methyl iodide (Iodomethane)

List of Hazardous Air Pollutants By CAS Number (Continued)

CAS Number*	HAP Name
75003	Ethyl Chloride (Chloroethane)
75014	Vinyl chloride
75058	Acetonitrile
75070	Acetaldehyde
75092	Methylene chloride (Dichloromethane)
75150	Carbon disulfide
75218	Ethylene oxide
75252	Bromoform
75343	Ethylidene dichloride (1,1-Dichloroethane)
75354	Vinylidene chloride (1,1-Dichloroethylene)
75445	Phosgene
75558	1,2-Propylenimine (2-Methylaziridine)
75569	Propylene oxide
76448	Heptachlor
77474	Hexachlorocyclopentadiene
77781	Dimethyl sulfate
78591	Isophorone
78875	Propylene dichloride (1,2-Dichloropropane)
78933	Methyl ethyl ketone (2-Butanone)
79005	1,1,2-Trichloroethane
79016	Trichloroethylene
79061	Acrylamide
79107	Acrylic acid
79118	Chloroacetic acid
79345	1,1,2,2-Tetrachloroethane
79447	Dimethyl carbamoyl chloride
79469	2-Nitropropane
80626	Methyl methacrylate
82688	Pentachloronitrobenzene (Quintobenzene)
84742	Dibutyl phthalate
85449	Phthalic anhydride
87683	Hexachlorobutadiene
87865	Pentachlorophenol
88062	2,4,6-Trichlorophenol
90040	o-Anisidine
91203	Naphthalene
91225	Quinoline
91941	3,3-Dichlorobenzidene
92524	Biphenyl
92671	4-Aminobiphenyl
92875	Benzidine
92933	4-Nitrobiphenyl
94757	2,4-D, (salts and esters)
95476	o-Xylenes
95487	o-Cresol
95534	o-Toluidine
95807	2,4-Toluene diamine
95954	2,4,5-Trichlorophenol
96093	Styrene oxide

List of Hazardous Air Pollutants By CAS Number (Continued)

CAS Number*	HAP Name
96128	1,2-Dibromo-3-chloropropane
96457	Ethylene thiourea
98077	Benzotrichloride
98828	Cumene
98862	Acetophenone
98953	Nitrobenzene
100027	4-Nitrophenol
100414	Ethyl benzene
100425	Styrene
100447	Benzyl chloride
101144	4,4-Methylene bis(2-chloroaniline)
101688	Methylene diphenyl diisocyanate (MDI)
101779	4,4'-Methylenedianiline
106423	p-Xylenes
106445	p-Cresol
106467	1,4-Dichlorobenzene (p)
106503	p-Phenylenediamine
106514	Quinone
106887	1,2-Epoxybutane
106898	Epichlorohydrin (l-Chloro-2,3-epoxypropane)
106934	Ethylene dibromide (Dibromoethane)
106990	1,3-Butadiene
107028	Acrolein
107051	Allyl chloride
107062	Ethylene dichloride (1,2-Dichloroethane)
107131	Acrylonitrile
107211	Ethylene glycol
107302	Chloromethyl methyl ether
108054	Vinyl acetate
108101	Methyl isobutyl ketone (Hexone)
108316	Maleic anhydride
108383	m-Xylenes
108394	m-Cresol
108883	Toluene
108907	Chlorobenzene
108952	Phenol
110543	Hexane
111422	Diethanolamine
111444	Dichloroethyl ether (Bis[2-chloroethyl]ether)
114261	Propoxur (Baygon)
117817	Bis(2-ethylhexyl)phthalate (DEHP)
118741	Hexachlorobenzene
119904	3,3-Dimethoxybenzidine
119937	3,3'-Dimethyl benzidine
120809	Catechol
120821	1,2,4-Trichlorobenzene
121142	2,4-Dinitrotoluene
121448	Triethylamine
121697	N,N-diethyl aniline (N,N-Dimethylaniline)

List of Hazardous Air Pollutants By CAS Number (Continued)

CAS Number*	HAP Name
122667	1,2-Diphenylhydrazine
123319	Hydroquinone
123386	Propionaldehyde
123911	1,4-Dioxane (1,4-Diethyleneoxide)
126998	Chloroprene
127184	Tetrachloroethylene (Perchloroethylene)
131113	Dimethyl phthalate
132649	Dibenzofurans
133062	Captan
133904	Chloramben
140885	Ethyl acrylate
151564	Ethylene imine (Aziridine)
156627	Calcium cyanamide
302012	Hydrazine
334883	Diazomethane
463581	Carbonyl sulfide
510156	Chlorobenzilate
532274	2-Chloroacetophenone
534521	4,6-Dinitro-o-cresol and salts
540841	2,2,4-Trimethylpentane
542756	1,3-Dichloropropene
542881	Bis(chloromethyl) ether
584849	2,4-Toluene diisocyanate
593602	Vinyl bromide
624839	Methyl isocyanate
680319	Hexamethylphosphoramide
684935	N-Nitroso-N-methylurea
822060	Hexamethylene-1,6-diisocyanate
1120714	1,3-Propane sultone
1319773	Cresols/Cresylic acid (isomers and mixture)
1330207	Xylenes (isomers and mixture)
1332214	Asbestos
1336363	Polychlorinated biphenyls (Aroclors)
1582098	Trifluralin
1634044	Methyl tert-butyl ether
1746016	2,3,7,8-Tetrachlorodibenzo-p-Dioxin
7550450	Titanium tetrachloride
7647010	Hydrochloric acid
7664393	Hydrogen fluoride (Hydrofluoric acid)
7782505	Chlorine
7803512	Phosphine
8001352	Toxaphene (chlorinated camphene)

*N/A: No CAS number for metals, metal compounds, and mixtures.

APPENDIX B

ALPHABETICAL LISTING OF

HAZARDOUS AIR POLLUTANTS

Alphabetical Listing of Hazardous Air Pollutants

HAP Name	CAS Number*
1,1,2,2-Tetrachloroethane	79345
1,1,2-Trichloroethane	79005
1,1-Dimethyl hydrazine	57147
1,2,4-Trichlorobenzene	120821
1,2-Dibromo-3-chloropropane	96128
1,2-Diphenylhydrazine	122667
1,2-Epoxybutane	106887
1,2-Propylenimine (2-Methylaziridine)	75558
1,3-Butadiene	106990
1,3-Dichloropropene	542756
1,3-Propane sultone	1120714
1,4-Dichlorobenzene (p)	106467
1,4-Dioxane (1,4-Diethyleneoxide)	123911
2,2,4-Trimethylpentane	540841
2,3,7,8-Tetrachlorodibenzo-p-Dioxin	1746016
2,4,5-Trichlorophenol	95954
2,4,6-Trichlorophenol	88062
2,4-D, (salts and esters)	94757
2,4-Dinitrophenol	51285
2,4-Dinitrotoluene	121142
2,4-Toluene diamine	95807
2,4-Toluene diisocyanate	584849
2-Acetylaminofluorene	53963
2-Chloroacetophenone	532274
2-Nitropropane	79469
3,3-Dichlorobenzidene	91941
3,3-Dimethoxybenzidine	119904
3,3'-Dimethyl benzidine	119937
4,4-Methylene bis(2-chloroaniline)	101144
4,4'-Methylenedianiline	101779
4,6-Dinitro-o-cresol and salts	534521
4-Aminobiphenyl	92671
4-Nitrobiphenyl	92933
4-Nitrophenol	100027
Acetaldehyde	75070
Acetamide	60355
Acetonitrile	75058
Acetophenone	98862
Acrolein	107028
Acrylamide	79061
Acrylic acid	79107
Acrylonitrile	107131
Allyl chloride	107051
Aniline	62533
Antimony Compounds	N/A
Arsenic Compounds(inorganic including arsine)	N/A
Asbestos	1332214
Benzene (including benzene from gasoline)	71432
Benzidine	92875

Alphabetical Listing of Hazardous Air Pollutants (Continued)

HAP Name	CAS Number*
Benz otrichloride	98077
Benzyl chloride	100447
Beryllium Compounds	N/A
Beta-propiolactone	57578
Biphenyl	92524
Bis(2-ethylhexyl)phthalate (DEHP)	117817
Bis(chloromethyl) ether	542881
Bromoform	75252
Cadmium Compounds	N/A
Calcium cyanamide	156627
Captan	133062
Carbaryl	63252
Carbon disulfide	75150
Carbon tetrachloride	56235
Carbonyl sulfide	463581
Catechol	120809
Chloramben	133904
Chlordane	57749
Chlorine	7782505
Chloroacetic acid	79118
Chlorobenzene	108907
Chlorobenzilate	510156
Chloroform	67663
Chloromethyl methyl ether	107302
Chloroprene	126998
Chromium Compounds	N/A
Cobalt Compounds	N/A
Coke Oven Emissions	N/A
Cresols/Cresylic acid (isomers and mixture)	1319773
Cumene	98828
Cyanide Compounds	N/A
DDE (1,1-dichloro-2,2-bis(p- chlorophenyl) ethylene)	72559
Diazomethane	334883
Dibenzofurans	132649
Dibutyl phthalate	84742
Dichloroethyl ether (Bis[2-chloroethyl]ether)	111444
Dichlorvos	62737
Diethanolamine	111422
Diethyl sulfate	64675
Dimethyl formamide	68122
Dimethyl phthalate	131113
Dimethyl sulfate	77781
Dimethyl aminoazobenzene	60117
Dimethyl carbamoyl chloride	79447
Epichlorohydrin (l-Chloro-2,3-epoxypropane)	106898
Ethyl acrylate	140885
Ethyl carbamate (Urethane)	51796
Ethyl Chloride (Chloroethane)	75003
Ethyl benzene	100414

Alphabetical Listing of Hazardous Air Pollutants (Continued)

HAP Name	CAS Number*
Ethylene dibromide (Dibromoethane)	106934
Ethylene dichloride (1,2-Dichloroethane)	107062
Ethylene glycol	107211
Ethylene oxide	75218
Ethylene thiourea	96457
Ethylene imine (Aziridine)	151564
Ethylidene dichloride (1,1-Dichloroethane)	75343
Fine Mineral Fibers	N/A
Formaldehyde	50000
Glycol ethers	N/A
Heptachlor	76448
Hexachlorobenzene	118741
Hexachlorobutadiene	87683
Hexachlorocyclopentadiene	77474
Hexachloroethane	67721
Hexamethylene-1,6-diisocyanate	822060
Hexamethylphosphoramide	680319
Hexane	110543
Hydrazine	302012
Hydrochloric acid	7647010
Hydrogen fluoride (Hydrofluoric acid)	7664393
Hydroquinone	123319
Isophorone	78591
Lead Compounds	N/A
Lindane (all isomers)	58899
Maleic anhydride	108316
Manganese Compounds	N/A
m-Cresol	108394
Mercury Compounds	N/A
Methanol	67561
Methoxychlor	72435
Methyl bromide (Bromomethane)	74839
Methyl chloride (Chloromethane)	74873
Methyl chloroform (1,1,1-Trichloroethane)	71556
Methyl ethyl ketone (2-Butanone)	78933
Methyl iodide (Iodomethane)	74884
Methyl isobutyl ketone (Hexone)	108101
Methyl isocyanate	624839
Methyl methacrylate	80626
Methyl tert-butyl ether	1634044
Methylene chloride (Dichloromethane)	75092
Methylene diphenyl diisocyanate (MDI)	101688
Methylhydrazine	60344
m-Xylenes	108383
N,N-diethyl aniline (N,N-Dimethylaniline)	121697
Naphthalene	91203
Nickel Compounds	N/A
Nitrobenzene	98953
N-Nitrosodimethylamine	62759

Alphabetical Listing of Hazardous Air Pollutants (Continued)

HAP Name	CAS Number*
N-Nitrosomorpholine	59892
N-Nitroso-N-methylurea	684935
o-Anisidine	90040
o-Cresol	95487
o-Toluidine	95534
o-Xylenes	95476
Parathion	56382
p-Cresol	106445
Pentachloronitrobenzene (Quintobenzene)	82688
Pentachlorophenol	87865
Phenol	108952
Phosgene	75445
Phosphine	7803512
Phosphorous Compounds	N/A
Phthalic anhydride	85449
Polychlorinated biphenyls (Aroclors)	1336363
Polycyclic Organic Matter	N/A
p-Phenylenediamine	106503
Propionaldehyde	123386
Propoxur (Baygon)	114261
Propylene dichloride (1,2-Dichloropropane)	78875
Propylene oxide	75569
p-Xylenes	106423
Quinoline	91225
Quinone	106514
Radionuclides (including radon)	N/A
Selenium Compounds	N/A
Styrene	100425
Styrene oxide	96093
Tetrachloroethylene (Perchloroethylene)	127184
Titanium tetrachloride	7550450
Toluene	108883
Toxaphene (chlorinated camphene)	8001352
Trichloroethylene	79016
Triethylamine	121448
Trifluralin	1582098
Vinyl acetate	108054
Vinyl bromide	593602
Vinyl chloride	75014
Vinylidene chloride (1,1-Dichloroethylene)	75354
Xylenes (isomers and mixture)	1330207

*N/A: No CAS number for metals, metal compounds, and mixtures.

APPENDIX C

HAZARDOUS AIR POLLUTANTS

SYNONYM LIST

Hazardous Air Pollutants Synonym List

CAS Num	HAP Name	Synonyms
79345	1,1,2,2-Tetrachloroethane	Tetrachloroethane
79005	1,1,2-Trichloroethane	Vinyl Trichloride; 1,2,2-Trichloroethane
57147	1,1-Dimethylhydrazine	N,N-Dimethylhydrazine
120821	1,2,4-Trichlorobenzene	1,2,4-Trichlorobenzol
96128	1,2-Dibromo-3-chloropropane	3-Chloro-1,2-dibromopropane
122667	1,2-Diphenylhydrazine	Hydrazobenzene
106887	1,2-Epoxybutane	1,2-Butylene Oxide; 1,2-Butene oxide
75558	1,2-Propylenimine	2-Methylaziridine; Methylethylenimine
106990	1,3-Butadiene	Butadiene
542756	1,3-Dichloropropene	Isomer Mixture includes: Cis-1,3-Dichloropropene; Trans-1,3-Dichloropropene
1120714	1,3-Propane sultone	1,2-Oxathiolane 2,2-dioxide
106467	1,4-Dichlorobenzene(p)	p-Dichlorobenzene; para-Dichlorobenzene
123911	1,4-Dioxane	1,4-Diethyleneoxide
540841	2,2,4-Trimethylpentane	Isooctane
1746016	2,3,7,8-Tetrachlorodibenzo-p-dioxin	TCDD; 2,3,7,8-TCDD
95954	2,4,5-Trichlorophenol	Dowicide 2; Dowicide B
88062	2,4,6-Trichlorophenol	Dowicide 2S; Phenachlor
94757	2,4-D, (salts and esters)	2,4-D (2,4-Dichlorophenoxyacetic Acid)(including salts and esters)
51285	2,4-Dinitrophenol	Aldifen; 2,4-DNP
121142	2,4-Dinitrotoluene	DNT; 1-Methyl-2,4-dinitrobenzene
95807	2,4-Toluene diamine	Toluene-2,4-diamine; TDA; 2,4-Diaminotoluene
584849	2,4-Toluene diisocyanate	2,4-Diisocyanatotoluene; Toluene 2,4-Diisocynate; TDI
53963	2-Acetylaminofluorene	2-Acetamidofluorene
532274	2-Chloroacetophenone	2-Chloro-1-phenylethanone
79469	2-Nitropropane	2-NP; Dimethylnitromethane
91941	3,3-Dichlorobenzidene	4,4-Diamino-3,3-dichlorobiphenyl
119904	3,3-Dimethoxybenzidine	o,o-Diansidine
119937	3,3'-Dimethylbenzidine	o-Tolidine
101144	4,4-Methylenebis(2-chloroaniline)	4,4'-Methylenebis[2-chlorobenzenamine]
101779	4,4'-Methylenedianiline	4-(4-Aminobenzyl)aniline; MDA
534521	4,6-Dinitro-o-cresol (and salts)	
92671	4-Aminobiphenyl	p-Aminodiphenyl; p-Phenylaniline
92933	4-Nitrobiphenyl	p-Nitrobiphenyl
100027	4-Nitrophenol	p-Nitrophenol, 4-Hydroxynitrobenzene,
75070	Acetaldehyde	Ethanal; Acetic Aldehyde
60355	Acetamide	Acetic acid amide
75058	Acetonitrile	Methyl cyanide; Cyanomethane
98862	Acetophenone	1-Phenylethanone
107028	Acrolein	2-Propenal; Acrylic aldehyde; Acrylaldehyde
79061	Acrylamide	Propenamide; Vinyl amide
79107	Acrylic acid	2-Propenoic acid; Propene acid
107131	Acrylonitrile	2-Propenenitrile; Vinyl cyanide
107051	Allyl chloride	3-Chloro-1-propene
62533	Aniline	Benzenamine
N/A	Antimony Compounds	
N/A	Arsenic Compounds(inorganic including arsine)	
1332214	Asbestos	

Hazardous Air Pollutants Synonym List (Continued)

CAS Num	HAP Name	Synonyms
71432	Benzene (including benzene from gasoline)	Benzol; including benzene from gasoline
92875	Benzidine	[1,1'-Biphenyl]-4,4'-diamine
98077	Benzotrichloride	Trichloromethylbenzene; Trichlorotoluene
100447	Benzyl chloride	Chloromethylbenzene; Chlorotoluene
N/A	Beryllium Compounds	
57578	beta-Propiolactone	2-Oxetanone
92524	Biphenyl	Phenyl benzene
117817	Bis(2-ethylhexyl)phthalate (DEHP)	DEHP; Di(2-EthylHexyl) Phthalate
542881	Bis(chloromethyl) ether	Oxybis(chloromethane); Bis-CME
75252	Bromoform	Tribromomethane
N/A	Cadmium Compounds	
156627	Calcium cyanamide	Cyanogas
133062	Captan	N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide; Orthocide
63252	Carbaryl	1-Naphthalenol methylcarbamate
75150	Carbon disulfide	Carbon bisulfide
56235	Carbon tetrachloride	Tetrachloromethane
463581	Carbonyl sulfide	Carbon oxysulfide
120809	Catechol	1,2-Benzenediol
133904	Chloramben	3-Amino-2,5-dichlorobenzoic acid
57749	Chlordane	Dichlorodene; Dowchlor; Octachlor
7782505	Chlorine	
79118	Chloroacetic acid	Chloroethanoic acid
108907	Chlorobenzene	Monochlorobenzene; Benzene chloride
510156	Chlorobenzilate	4-Chloro-a-(4-chlorophenyl)-a-hydroxybenzeneacetic acid
67663	Chloroform	Trichloromethane
107302	Chloromethyl methyl ether	Chloromethoxymethane
126998	Chloroprene	2-Chloro-1,3-butadiene
N/A	Chromium Compounds	
N/A	Cobalt Compounds	
N/A	Coke Oven Emissions	
1319773	Cresol/Cresylic acid (mixed isomers)	Cresols; Cresylol; Toluenol
98828	Cumene	Isopropyl Benzene
N/A	Cyanide Compounds	Isopropyl Cyanide; Isobutyronitrile; Isopropylnitrile
3547044	DDE (1,1-dichloro-2,2-bis(p-chlorophenyl) ethylene)	DDE
334883	Diazomethane	Azimethylene
132649	Dibenzofurans	Furans
84742	Dibutyl phthalate	Di-n-butylphthalate
111444	Dichloroethyl ether (Bis[2-chloroethyl]ether)	Bis(2-chloroethyl)ether
62737	Dichlorvos	Phosphoric acid 2,2-dichloroethenyl dimethyl ester
111422	Diethanolamine	2,2'-Iminobisethanol
64675	Diethyl sulfate	Sulfuric acid diethyl ester
60117	Dimethyl aminoazobenzene	4-Dimethylaminoazobenzene
79447	Dimethyl carbamoyl chloride	Dimethyl carbamic acid
68122	Dimethyl formamide	N,N-Dimethylformamide
131113	Dimethyl phthalate	1,2-Benzenedicarboxylic acid dimethy ester
77781	Dimethyl sulfate	Sulfuric acid dimethyl ester
106898	Epichlorohydrin	l-Chloro-2,3-epoxypropane

Hazardous Air Pollutants Synonym List (Continued)

CAS Num	HAP Name	Synonyms
140885	Ethyl acrylate	2-Propenoic acid ethyl ester
100414	Ethylbenzene	Ethylbenzol; Phenylethane
51796	Ethyl carbamate (Urethane)	Urethane; Chloroethane
75003	Ethyl Chloride (Chloroethane)	Chloroethane
106934	Ethylene dibromide (Dibromoethane)	Dibromoethane; 1,2-Dibromoethane
107062	Ethylene dichloride (1,2-Dichloroethane)	1,2-Dichloroethane
107211	Ethylene glycol	1,2-Ethanediol
151564	Ethylene imine (Aziridine)	Aziridine
75218	Ethylene oxide	Oxirane
96457	Ethylene thiourea	2-Mercaptoimidazoline
75343	Ethylidene dichloride (1,1-Dichloroethane)	1,1-Dichloroethane
N/A	Fine mineral fibers	
50000	Formaldehyde	Methanal
N/A	Glycol ethers	Glycol ethers (and their acetates)
76448	Heptachlor	3-Chlorochlordene; Heptachlorane
118741	Hexachlorobenzene	Perchlorobenzene; HCB
87683	Hexachlorobutadiene	Hexachloro-1,3-Butadiene
77474	Hexachlorocyclopentadiene	Hexachloro-1,3-Cyclopentadiene
67721	Hexachloroethane	Carbon hexachloride; Ethane hexachloride
822060	Hexamethylene-1,6-diisocyanate	Hexamethylene diisocyanate
680319	Hexamethylphosphoramide	Hexamethylphosphoric acid triamide
110543	Hexane	n-Hexane
302012	Hydrazine	Hydrazine anhydrous
7647010	Hydrochloric acid	Hydrogen Chloride; gas only
7664393	Hydrogen fluoride (Hydrofluoric acid)	Hydrofluoric Acid
123319	Hydroquinone	Dihydroquinone
78591	Isophorone	Isoacetophorone
N/A	Lead Compounds	
58899	Lindane (all isomers)	Hexachlorocyclohexane
108316	Maleic anhydride	2,5-Furandione
N/A	Manganese Compounds	
108394	m-cresol	Cresol/Cresylic acid (mixed isomers)
N/A	Mercury Compounds	
67561	Methanol	Methyl alcohol
72435	Methoxychlor	1,1'-(2,2,2-Trichloroethylidene)-bis[4-methoxybenzene]
74839	Methyl bromide (Bromomethane)	Bromomethane
74873	Methyl chloride (Chloromethane)	Chloromethane
71556	Methyl chloroform (1,1,1-Trichloroethane)	1,1,1-Trichloroethane
78933	Methyl ethyl ketone (2-Butanone)	MEK; 2-Butanone
74884	Methyl iodide (Iodomethane)	Iodomethane
108101	Methyl isobutyl ketone (Hexone)	MIK; Hexone
624839	Methyl isocyanate	Isocyanic acid, methyl ester
80626	Methyl methacrylate	Methyl ester methacrylic acid
1634044	Methyl tert-butyl ether	MTBE
75092	Methylene chloride (Dichloromethane)	Dichloromethane
101688	Methylene diphenyl diisocyanate (MDI)	MDI; MethyleneBis (Phenylisosyanate); Methylene Biphenyl Isocyanate
60344	Methylhydrazine	Monomethylhydrazine

Hazardous Air Pollutants Synonym List (Continued)

CAS Num	HAP Name	Synonyms
108383	m-Xylenes	1,3-Dimethyl benzene
121697	N,N-Dimethyl aniline	N,N-Dimethylbenzenamine
91203	Naphthalene	White tar; Camphor tar
N/A	Nickel Compounds	
98953	Nitrobenzene	Nitrobenzol
62759	N-Nitrosodimethylamine	N-Methyl-N-nitroso-methanamine
59892	N-Nitrosomorpholine	4-Nitrosomorpholine
684935	N-Nitroso-N-methylurea	NHU; N-nitroso-n-methylcarbamide
90040	o-Anisidine	2-Anisidine; 2-Methoxy-1-Aminobenzene
95487	o-cresol	Cresol/Cresylic acid (mixed isomers)
95534	o-Toluidine	2-Aminotoluene
95476	o-Xylenes	1,2-Dimethyl benzene
56382	Parathion	Phosphorothioic acid O,O-diethyl O-(4-nitrophenyl) ester
106445	p-cresol	Cresol/Cresylic acid (mixed isomers)
82688	Pentachloronitrobenzene (Quintobenzene)	Quintobenzene; Quintozene
87865	Pentachlorophenol	Penta; PCP
108952	Phenol	Carbolic acid
75445	Phosgene	Carbonic dichloride
7803512	Phosphine	Hydrogen phosphide
N/A	Phosphorous Compounds	
85449	Phthalic anhydride	1,3-Isobenzenofurandione
1336363	Polychlorinated biphenyls (Aroclors)	Arochlors
N/A	Polycyclic Organic Matter	POM
106503	p-Phenylenediamine	1,4-Benzenediamine
123386	Propionaldehyde	Propanal
114261	Propoxur (Baygon)	2-(1-Methylethoxy)phenol methyl carbamate; Baygon
78875	Propylene dichloride (1,2-Dichloropropane)	1,2-Dichloropropane
75569	Propylene oxide	Methyloxirane
106423	p-Xylenes	1,4-Dimethyl benzene
91225	Quinoline	Leucoline; chinoleine
106514	Quinone	p-Benzoquinone; 2,5-Cyclohexadiene-1,4-dione
N/A	Radionuclides (including radon)	
N/A	Selenium Compounds	
100425	Styrene	Ethenylbenzene, Cinnamene, Phenylethylene, Vinyl benzene, Vinylbenzol
96093	Styrene oxide	Epoxystyrene
127184	Tetrachloroethylene (Perchloroethylene)	Perchloroethylene; Perc
7550450	Titanium tetrachloride	Titanium chloride
108883	Toluene	Methylbenzene
8001352	Toxaphene (chlorinated camphene)	Chlorinated camphene; camphechlor
79016	Trichloroethylene	Trichloroethene; TCE
121448	Triethylamine	N,N-Diethylethanamine
1582098	Trifluralin	2,6-Dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine
108054	Vinyl acetate	Acetic acid ethenyl ester; acetic acid vinyl ester
593602	Vinyl bromide	Bromoethene; Bromoethylene
75014	Vinyl chloride	Chloroethylene
75354	Vinylidene chloride (1,1-Dichloroethylene)	1,1-Dichloroethylene; 1,1-Dichloroethene
1330207	Xylenes (mixed isomers)	Dimethyl benzenes

APPENDIX D

LIST OF AVAILABLE EIIP DOCUMENTS

http:/www.epa.gov/oar/oaqps/eiip/

List of Available EIIP Documents

Volume I: Introduction

Introduction and Use of EIIP Guidance for Emissions Inventory Development

Volume II: Point Sources

Chapter 1: Introduction to Stationary Point Source Emission Inventory Development

Chapter 2: Preferred and Alternative Methods for Estimating Air Emissions from Boilers

Chapter 3: Preferred and Alternative Methods for Estimating Air Emissions from Hot-Mix Asphalt Plants

Chapter 4: Preferred and Alternative Methods for Estimating Air Emissions from Equipment Leaks

Chapter 5: Preferred and Alternative Methods for Estimating Air Emissions from Wastewater Collection and Treatment Facilities

Chapter 6: Preferred and Alternative Methods for Estimating Air Emissions from Semiconductor Manufacturing

Chapter 7: Preferred and Alternative Methods for Estimating Air Emissions from Surface Coating Operations

Chapter 8: Preferred and Alternative Methods for Estimating Air Emissions from Paint and Ink Manufacturing

Chapter 9: Preferred and Alternative Methods for Estimating Air Emissions from Secondary Metal Processing

Chapter 10: Preferred and Alternative Methods for Estimating Air Emissions from Oil and Gas Field Production and Processing Operations

Chapter 11: Preferred and Alternative Methods for Estimating Air Emissions from Plastic Products Manufacturing

Chapter 13: Technical Assessment Paper: Available Information for Estimating Air Emissions from Stone Mining and Quarrying Operations

Volume III: Area Sources

Chapter 1: Introduction to Area Source Emission Inventory Development

Chapter 2: Residential Wood Combustion

Chapter 3: Architectural Surface Coating

Chapter 4: Dry Cleaning

Chapter 5: Consumer and Commercial Solvent

Chapter 6: Solvent Cleaning

Chapter 7: Graphic Arts

Chapter 8: Industrial Surface Coating

Chapter 9: Pesticides - Agricultural and Nonagricultural

Chapter 10: Agricultural Operations

Chapter 11: Gasoline Marketing

Chapter 12: Marine Vessel Loading, Ballasting and Transit

Chapter 13: Autobody Refinishing

Chapter 14: Traffic Paints

Chapter 15: Municipal Landfills

Chapter 17: Asphalt Paving

Volume IV: Mobile Sources

Chapter 1: Preferred and Alternative Methods for Gathering and Locating Specific Emission Inventory Data

Chapter 2: Use of Locality-Specific Transportation Data for the Development of Mobile Source Emission Inventories

Chapter 3: Guidance for Estimating Lawn and Garden Equipment Activity Levels

Volume V: Biogenic Sources

Biogenic Sources Preferred Methods

Volume VI: Quality Assurance Procedures

Chapter 1: Introduction: The Value of QA/QC

Chapter 2: Planning and Documentation

Chapter 3: General QA/QC Methods

Chapter 4: Evaluating the Uncertainty of Emission Estimates

Chapter 5: Model QA Plan

Appendix A: Example Audit Report

Appendix B: Technical Systems Audit Checklist Example

Appendix C: Example 1 of Data Quality Audit Checklist

Appendix D: Example 2 of Data Quality Audit Checklist

Appendix E: Performance Evaluation Checklist Example

Appendix F: EIIP Recommended Approach to Using the Data Attribute System (DARS)

DARS User Manual, Beta Version 1.1

DARS Software Beta Version 1.1

Volume VII: Data Management Procedures

EIIP Phase I Data Model

Prototype Version EIIP EDI Implementation Guidelines (for air emission modeling data), Prototype Version

Prototype Demonstration for Data Transfer Method with Approach Study: Final Action Plan

Volume VII: Data Management Procedures (Continued)

Report Assessing the Procurement and Management of EDI Translators

Report on Maintenance Issues Associated with the EDI X12 Convention Document

APPENDIX E

CONTACTS

APPENDIX E1

LIST OF EPA REGIONAL OFFICE

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APPENDIX E2

LIST OF EIIP CONTACTS

http:/www.epa.gov/oar/oaqps/eiip/

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APPENDIX F

OVERVIEW OF REFERENCE MATERIALS

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OVERVIEW OF REFERENCE MATERIALS

Aerometric Information Retrieval System (AIRS)

The Aerometric Information Retrieval System (AIRS) is a computer-based repository of information about airborne pollution. The Airs Facility Subsystem (AFS) contains emissions, compliance data, and permit data for stationary sources. AFS data is used primarily by states in preparation of State Implementation Plans (SIPs) and SIP inventories. Types of data stored in AFS include:

- Facility name, location, and SIC code;
- Stack parameters;
- Process-specific operating schedule;
- SCC codes;
- Annual process rate, and fuel parameters; and
- Annual emissions estimates for criteria pollutants.

AFS is used by some states as a repository of HAP emissions and facility specific data. Some states update HAP information in AFS regularly on an annual basis or whenever changes occur to a facility or its operation. Currently there is **NO** mandatory requirement by EPA for states to report HAP emissions in AFS.

If data in AFS are going to be used for HAP inventory preparation purposes, it is important to understand the appropriate applications and limitations of the data. The completeness of the data in AIRS for a given state can be evaluated by determining the extent of HAP and source category coverage. For example, states may elect to report HAP emissions in AFS only for certain regions or nonattainment areas in the state; thus, not reporting a complete inventory of HAP emissions for the entire state.

In regard to HAP coverage, it is important to consider the reporting thresholds that states have for HAP emissions. Some states require facilities to quantify and report speciated HAP emissions for any HAP emitted beyond a certain threshold. However, some states only require facilities to simply identify, but not quantify, those HAPs that are emitted beyond the requirement threshold.

It is important to know the basis of the HAP emissions in AFS--whether they are reported as actual, potential (controlled or uncontrolled), permitted, or measured emissions. Depending on the emission type, emissions may be entered in AFS on a plant or segment level. Knowing the emission type and level that a state uses for reporting data will assist in downloading data from

AFS. Manuals may be downloaded from the Internet at *http://ttnwww.rtpnc.epa.gov/html/airs/airs.htm#ASIR.*

AFS can also be used to identify facilities that are subject to a MACT standard; however, this can only be done for states that designate facilities that are subject to a MACT standard. AFS allows states to report information pertaining to MACT standards, such as indicating the MACT category that applies to a facility and the MACT compliance status (whether the facility is in compliance with the MACT standard). Although reporting MACT standard information in AFS is voluntary, this information may be used to assist in MACT floor determination. If MACT information is not available in AFS, SCC codes can be used to determine the MACT that may apply to a facility.

The AIRS database resides on EPA's mainframe computer system and is not a publicly available database that can be accessed from the web. In order to retrieve information directly from AIRS, you need to obtain an account on the EPA mainframe computer system and pay the applicable computer usage charges. Information about obtaining a computer account is available by calling 1-800-334-2405 (toll free) or 919-541-7862.

AIRSWeb

The AIRSWeb gives access to air pollution data for the entire United States. AIRSWeb is a collection of the most significant AIRS data elements. AIRSWeb "Source Reports" display estimates of annual emissions of criteria pollutants from individual point sources, and number of sources and total pollutant emissions by industry. Specifically, there are six Source Reports that can be generated from AIRSWeb:

- Ranking: Lists each source in order of its pollutant emissions, ranking them from largest to smallest;
- Compliance: Indicates whether each source is complying with regulations governing air pollutant emissions;
- Address: The name and address of each source plus additional descriptive information;
- Count: The number of sources and total air pollutant emissions for each geographic area (county, state, or EPA region);
- SIC: The number of sources and total air pollutant emissions for each SIC; and
- Year: The number of sources that submitted emissions estimates for each calendar year (indicates how recent are the data).

AIRSWeb data collection is refreshed monthly, usually on the first Tuesday. AIRSWeb reports can be accessed on the World Wide Web at *http://www.epa.gov/airsweb/sources.htm.*

National Toxics Inventory

The 1993 National Toxics Inventory (NTI) database contains county-level air toxics data for the 188 HAPs for hundreds of major, area, and mobile source categories. Source categories included in the NTI are classified by SIC codes, SCC codes, AMS codes, or hybrid NTI category codes.

Specifically, the data contained in the NTI includes annual emissions at the state and county levels. The NTI air toxics data are compiled from a variety of sources including:

- CAA-mandated studies including Section 112(c)(6) and Section 112(k);
- State air toxics programs;
- TRI data;
- Data generated in support of the MACT standards program; and
- Industry and trade group data.

Data elements included in the NTI database are:

- FIPS state code;
- FIPS county code;
- Source category code and description;
- Pollutant code and description; and
- Total state and county-level emissions.

Some of the limitations of the 1993 NTI are that the inventory does not directly contain facility-specific data. Most of the emissions estimates were developed using a top-down approach. However, some of the raw data used to compile the inventory such as TRI and MACT data, and some state and local inventory data were facility-specific.

While the NTI does not provide direct procedural guidance, the emissions data and background documentation for emission calculations used in preparing it can be helpful to you in preparing your own air toxics inventory. The *1996 Periodic Inventory Guidance* document includes this information and can be downloaded from OAQPS' web page at *http://www.epa.gov/oar/oaqps/efig/ei/*.

NTI is a work-in-progress and is currently being updated to a 1996 base year, and efforts are underway to incorporate facility-specific, major source inventory data for the 1996 base year.

NTI data can be downloaded off the World Wide Web through EPA's Web site at *http://www.epa.gov/ttn/chief/*.

The NET Database

The National Emissions Trends (NET) system is a national repository database compiled by EPA and includes EPA's latest estimates of national emissions for criteria pollutants. Non-criteria pollutants included in the inventory are HAPs, PM2.5, and ammonia. Estimates are contained in the inventory for the years 1900 to 1996, with increasing levels of detail in the more recent years.

The 1996 NET inventory includes state-submitted inventory data generated for the Ozone Transport Assessment Group (OTAG) and Grand Canyon Visibility Transport Commissions (GCVTC) and other inventory services. The NET inventory, does not necessarily include state data for any particular source or pollutant. However, EPA intends to provide statewide 1996 emissions inventory data on a county level basis to every state in the country.

The NET inventory can be used as a starting point in compiling a statewide air toxics inventory because the inventory includes some HAP emissions. Moreover, the NET inventory can be used to compile an initial list of emission sources in the state. Additional information on the NET inventory can be obtained through the EFIG's Emissions Inventory Web site at *http//www.epa.gov/oar/oaqps/efig/ei/* or from the Info CHIEF Help Desk at: (919) 541-5285.

Dun and Bradstreet Million Dollar Database

D&B Million Dollar Database provides information on over 1,000,000 U.S. leading public and private businesses. Company information includes name, address (including county), and industry information with up to 24 individual 8-digit SICs. The database also allows you to search for specific companies, or find companies within a specific industry group. Access to these databases is available on a subscription basis. Company data is updated every 60 days. The database can be accessed on the World Wide Web at *http://www.dnb.com/*.

Toxic Release Inventory

The EPA's Toxic Release Inventory (TRI) is a compilation of information about toxic chemicals used, manufactured, stored, treated, transported, or released into the environment. EPA stores TRI data in the Toxics Release Inventory System (TRIS). The TRI chemical list currently includes 579 individually-listed chemicals and 28 chemical categories. Some of the information included in the TRI database includes:

- Type of chemicals released into the local environment during the preceding year; and
- Quantity of each chemical that went into the air, water, and land in a particular year.

TRI data are best used when combined with information from other sources because of the following limitations associated with the TRI data:

- TRI covers only a subset of industrial sources. Non-industrial sources such as dry cleaners or automobile service stations are not covered in TRI;

- Only provides facility estimates reported as either stack or fugitive emissions; no breakout at the process level;

- Many point sources may not be required to report data to TRIS. Facilities must meet all of the following criteria in order to report data to TRIS;

    - Facilities that conduct manufacturing operations with SIC codes 20 through 39;
    - Facilities that have 10 or more full-time employees or their equivalent;
    - Facilities that manufacture, process, or otherwise use EPCRA Section 313 chemicals at the following thresholds: 25,000 lb/yr for manufacturing and processing, or 100,000 lb/yr otherwise used.

- TRI data are self-reported by the emitting facilities and reported releases may have been based upon estimation techniques rather than direct monitoring or testing, and therefore may not represent an accurate amount of release;

- TRI does not require a listing of all chemicals released, and thus, many releases go unreported. Moreover, chemicals may be added or deleted from the list. The EPCRA Information Hotline at (800) 535-0202 will provide up-to-date information on the status of the changes; and

- Five of the 188 HAPs are currently not required to be reported in TRI. These HAPs are: 2,2,4-trimethylpentane (540-84-1); 2,3,7,8-tetrachlorodibenzo-p-dioxin (1746-01-6); DDE (3547-04-4); coke oven emissions; and radionuclides.

TRI can be searched by pollutant, SIC, facility name, or location. Updated TRI lists of chemicals can be downloaded off the World Wide Web through EPA's Office of Pollution Prevention and Toxics Web site at *http://www.epa.gov/opptintr/tri/chemical.htm.* TRI reports are available in public libraries or can be downloaded off the World Wide Web at *http://www.epa.gov/opptintr/tri/access.htm*. The TRI database can also be searched online through the Right-To-Know Network (RTK NET) at *http://www.rtk.net/www/data/data_gen.html.*

Toxic Release Inventory Reporting Form R Guidance

Title III, Section 313 Release Reporting Guidance documents contain information to help industries comply with the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and Section 6607 of the Pollution Prevention Act of

1990. These manuals are intended to supplement the *Toxic Chemical Release Inventory Reporting Form R and Instruction*.

EPCRA Section 313 reporting requirements are discussed and the information needed to determine if an EPCRA 313 report must be prepared for a specific facility is presented. This discussion includes the definitions and lists required to make this decision. Threshold determination is explained in detail, including the step-by-step procedure with examples to clarify the process.

Detailed instructions for estimating releases are presented in each document. Again, a step-by-step approach is presented and illustrated with examples of the concepts presented and the calculations required. Industry-specific information includes a list of the commonly used EPCRA Section 313 chemicals; an overview of the industry processes; identification of appropriate chemical activities and reporting thresholds; methods for estimating quantities of chemicals released or otherwise managed; and discussion of common reporting errors.

The list of current TRI documents can be found in the reporting instructions that are sent to the facilities every year. Or, they can be obtained by calling EPA's Toxic Release Inventory Branch at (202) 260-3943.

The guidance documents that have been produced include:

- Monofilament fiber manufacture;
- Printing operations;
- Electrodeposition of organic coatings;
- Spray application of organic coatings;
- Semiconductor manufacture;
- Formulation of aqueous solutions;
- Electroplating operations;
- Textile dyeing;
- Presswood and laminated wood products manufacturing;
- Roller, knife, and gravure coating operations;
- Paper and paperboard production;
- Leather tanning and finishing processes;

- Wood preserving;
- Rubber production and compounding;
- Estimating releases and waste treatment efficiencies;
- Metal fabrication industry; and
- Food processors.

The following documents were updated in 1997 and can be obtained from the TRI Web site at *www.epa.gov/opptintr/tri/industry.html*:

- Metal mining ;
- Coal mining;
- RCRA Subtitle CTSD facilities and solvent recovery;
- Petroleum distribution;
- Electric generation; and
- Chemical distribution.

The following documents are being updated:

- Food processing;
- Metal fabrication;
- Electroplating;
- Semiconductors;
- Paper and paperboard;
- Printing operations;
- Spray application of organic coatings;
- Textiles;
- Rubber production;

- Electrodeposition;
- Presswood;
- Monofilament mfg;
- Roller, knife and gravure;
- Leather; and
- Wood preservation.

In addition, the following documents are being written:

- Smelting operations;
- Welding operations; and
- Incidental manufacture/byproducts.

APPENDIX G

LISTS OF FY99 105 GRANT, SECTION 112(c)(6), SECTION 112(k), AND GREAT WATERS HAPs

LISTS OF FY99 105 GRANT, SECTION 112(c)(6), SECTION 112(k), AND GREAT WATERS HAPs

HAP	CAS Number	FY99	112(c)(6)	112(k)*	Great Waters**
1,1,2,2-Tetrachloroethane	79345			X	
1,1,2-Trichloroethane	79005			X	
1,2-Dichloropropane (Propylene Dichloride)	78875			X+	
1,3-Butadiene	106990	X		X+	
1,3-Dichloropropene	542756			X+	
1,4-Dichlorobenzene	106467	X		X+	
2,3,7,8-TCDF/2,3,7,8-TCDD	n/a	X	X	X+	X
2,4-Toluene diisocyanate	584849	X			
Acetaldehyde	75070	X		X+	
Acrolein	107028	X		X+	
Acrylamide	79061	X		X	
Acrylonitrile	107131	X		X+	
Alkylated Lead Compounds	n/a		X		
Antimony & compounds	n/a	X			
Arsenic Compounds	n/a	X		X+	
Benzene	71432	X		X+	
Beryllium Compounds	n/a	X		X	
bis(2-chloroethyl)ether	111444	X			
Bis(2-ethylhexyl)phthalate	117817	X		X+	
Cadmium Compounds	n/a	X		X+	X
Carbon Tetrachloride	56235	X		X+	
Chlordane	57749				X
Chloroform	67663	X		X+	
Chromium Compounds	n/a	X		X+	
Coke Oven Emissions	n/a	X		X	
DDE	72559				X
Ethyl Acrylate	140885			X	
Ethylene Dibromide (1,2-Dibromoethane)	106934	X		X+	
Ethylene Dichloride (1,2-Dichloroethane)	107062	X		X+	
Ethylene Oxide	75218	X		X+	
Formaldehyde	50000	X		X+	
Glycol ethers	n/a	X			
Hexachlorobenzene	118741	X	X		X
Hydrazine	302012	X		X+	
Lead Compounds	n/a	X		X+	X
Lindane	58899				X
Manganese Compounds	n/a	X		X+	
Mercury Compounds	n/a	X	X	X+	X
Methyl Chloride (Chloromethane)	74873	X		X	
Methylene Chloride (Dichloromethane)	75902	X		X+	
Methylene Diphenyl Diisocyanate (MDI)	101688	X		X+	
Nickel Compounds	n/a	X		X+	
Phosgene	75445	X			

LISTS OF FY99 105 GRANT, SECTION 112(c)(6), SECTION 112(k), AND GREAT WATERS HAPs (CONTINUED)

HAP	CAS Number	FY99	112(c)(6)	112(k)*	Great Waters**
Polychlorinated Biphenyls	1336363		X		X
POM***	n/a	X	X	X+	X
Quinoline	91225			X	
Styrene	100425	X		X	
Tetrachloroethylene (Perchloroethylene)	127184	X		X+	
Toluene	108883	X			
Toxaphene	8001352				X
Trichloroethylene	79016	X		X+	
Vinyl Chloride	75014	X		X+	
Vinylidene Chloride	75354			X	
Xylenes	133027, 95476, 108383, 106423	X			

* The 112(k) Inventory included 40 potential urban area HAPs. The inventory played a role in identifying a list of 30 proposed urban area HAPs that were included in the regulatory analysis. The prepared urban area HAPs have been identified by a (+).

** Great Waters pollutants list also includes DDT, α-Hexachlorocyclohexane, Dieldrin, and Nitrogen compounds.

*** Inventory as sum of 16 PAH and speciate. 16 PAH compounds include:

Acenaphthene
Acenaphthylene
Anthracene Benz(a)anthracene
Benz(a)pyerene†
Benzo(b)fluoranthene†
Benzo(ghi)perylene†
Benzo(k)fluoranthene†
Chrysene†
Dibenz(a,h)anthracene†
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene†
Naphthalene
Phenanthrene
Pyrene

† These 7 PAHs are carcinogenic and are usually reported as the sum of 7 PAH

Note: The 41 HAPs identified for inventory under the FY99 105 Grant funds may change in future years.

APPENDIX H

HAP LIST

AND INDIVIDUAL CONSTITUENTS

[Note: This table includes individual HAPs currently in EPA's National Toxic Inventory. They do not include all HAPs that are listed in the Clean Air Act as components of HAP groups or mixtures.]

HAP List And Individual Constituents

Metals	
188 HAP Name	**Constituent**
Antimony Compounds	Antimony
Antimony Compounds	Antimony oxide
Antimony Compounds	Antimony pentafluoride
Antimony Compounds	Antimony trichloride
Antimony Compounds	Antimony trioxide
Antimony Compounds	Antimony trisulfide
Arsenic Compounds	Arsine
Arsenic Compounds	Arsenic
Arsenic Compounds	Arsenic acid
Arsenic Compounds	Arsenic compounds (inorganic)
Arsenic Compounds	Arsenic pentoxide
Arsenic Compounds	Arsenic trioxide
Chromium Compounds	Ammonium dichromate
Chromium Compounds	Calcium chromate
Chromium Compounds	Chromic acid
Chromium Compounds	Chromic oxide
Chromium Compounds	Chromic sulfate
Chromium Compounds	Chromium
Chromium Compounds	Chromium III
Chromium Compounds	Chromium +6
Chromium Compounds	Chromium chloride
Chromium Compounds	Chromium dioxide
Chromium Compounds	Chromium hydroxide
Chromium Compounds	Chromium trioxide
Chromium Compounds	Chromium zinc oxide
Chromium Compounds	Chromyl chloride
Chromium Compounds	Chromyl fluoride
Chromium Compounds	Lithium chromate
Chromium Compounds	Potassium chromate
Chromium Compounds	Sodium chromate
Chromium Compounds	Sodium dichromate
Chromium Compounds	Strontium chromate
Chromium Compounds	Zinc chromate
Chromium Compounds	Zinc chromates
Chromium Compounds	Zinc chromite Potassium dichromate
Lead Compound	Alkylated lead
Lead Compound	Lead
Lead Compound	Lead acetate
Lead Compound	Lead arsenate
Lead Compound	Lead arsenite
Lead Compound	Lead carbonate

HAP List And Individual Constituents (Continued)

Metals (Continued)	
188 HAP Name	**Constituent**
Lead Compound Glycol ethers	Lead chromate
Lead Compound	Lead chromate oxide
Lead Compound	Lead compounds (inorganic)
Lead Compound	Lead compounds (other than inorganic)
Lead Compound	Lead fluoroborate
Lead Compound	Lead mono oxide
Lead Compound	Lead naphthalene
Lead Compound	Lead neodecanoate
Lead Compound	Lead nitrate
Lead Compound	Lead oxide
Lead Compound	Lead phosphate
Lead Compound	Lead stearate
Lead Compound	Lead subacetate
Lead Compound	Lead sulfate
Lead Compound	Lead titanate
Lead Compound	Lead titanate zircon
Lead Compound	Tetraethyl lead
Manganese Compounds	Manganese
Manganese Compounds	Manganese dioxide
Manganese Compounds	Manganese naphthalene
Manganese Compounds	Manganese nitrate
Manganese Compounds	Manganese sulfate
Manganese Compounds	Manganese tallate
Manganese Compounds	Manganese tetroxide
Mercury compounds	Mercuric chloride
Mercury compounds	Mercury (organic)
Mercury compounds	Methyl mercury
Nickel compounds	Nickel
Nickel compounds	Nickel acetate
Nickel compounds	Nickel bromide
Nickel compounds	Nickel carbide
Nickel compounds	Nickel carbonate
Nickel compounds	Nickel carbonyl
Nickel compounds	Nicklel chloride
Nickel compounds	Nickel hydroxide
Nickel compounds	Nickel nitrate
Nickel compounds	Nickelocene
Nickel compounds	Nickel oxide
Nickel compounds	Nickel refinery dust from the pyrometallurgical
Nickel compounds	Nickel subsulfide
Nickel compounds	Nickel sulfamate
Nickel compounds	Nickel sulfate

HAP List And Individual Constituents (Continued)

Metals (Continued)	
188 HAP Name	**Constituent**
Phosphorous Compounds	Phosphoric acid
Phosphorous Compounds	Phosphorothioic acid
Phosphorous Compounds	Phosphorous acid
Phosphorous Compounds	Phosphorous nitride
Phosphorous Compounds	Phosphorous salt
Phosphorous Compounds	Phosphorus
Phosphorous Compounds	Phosphorus oxychloride
Phosphorous Compounds	Phosphorus pentasulfide
Phosphorous Compounds	Phosphorus pentoxide
Phosphorous Compounds	Phosphorus trichloride
Phosphorous Compounds	Phosphorus trioxide
Phosphorous Compounds	Triorthocresyl phosphate
Phosphorous Compounds	Triphenyl phosphate
Phosphorous Compounds	Triphenyl phosphite
Phosphorous Compounds	Zinc phosphate
Selenium Compounds	Selenium
Selenium Compounds	Selenium disulfide
Selenium Compounds	Selenium oxide
Selenium Compounds	Selenium sulfide

HAP List And Individual Constituents (Continued)

Glycol Ethers	
188 HAP Name	**Constituent**
Glycol ethers	1,1-Dimethoxyethane
Glycol ethers	1,2-Dimethoxyethane
Glycol ethers	1-Ethoxy-2-Propanol
Glycol ethers	1-Isobutoxy-2-Propanol
Glycol ethers	2-(2,4-Hexadienyloxy)Ethanol
Glycol ethers	2-(Hexyloxy)Ethanol
Glycol ethers	2-Butoxyethyl Acetate
Glycol ethers	2-Propoxyethyl Acetate
Glycol ethers	3-Butoxy-1-Propanol
Glycol ethers	3-Ethoxy-1-Propanol
Glycol ethers	3-Methoxy-1-Propanol
Glycol ethers	Butyl Carbitol Acetate
Glycol ethers	Butyl Cellosolve
Glycol ethers	Carbitol Acetate
Glycol ethers	Cellosolve Acetate
Glycol ethers	Cellosolve Solvent
Glycol ethers	Di(Ethylene Glycol Monobutyl Ether) Phthalate
Glycol ethers	Diethylene Glycol
Glycol ethers	Diethylene Glycol Di(3-Aminopropyl) Ether
Glycol ethers	Diethylene Glycol Dibenzoate
Glycol ethers	Diethylene Glycol Diglycidyl Ether
Glycol ethers	Diethylene Glycol Dimethyl Ether
Glycol ethers	Diethylene Glycol Dinitrate
Glycol ethers	Diethylene Glycol Divinyl Ether
Glycol ethers	Diethylene Glycol Ethyl Methyl Ether
Glycol ethers	Diethylene Glycol Ethylvinyl Ether
Glycol ethers	Diethylene Glycol Mono-2-Cyanoethyl Ether
Glycol ethers	Diethylene Glycol Monobutyl Ether
Glycol ethers	Diethylene Glycol Monoisobutyl Ether
Glycol ethers	Diethylene Glycol Monomethyl Ether
Glycol ethers	Diethylene Glycol Monovinyl Ether
Glycol ethers	Diethyleneglycol-Mono-2-Methyl-Pentyl Ether
Glycol ethers	(Ethylenebis(Oxyethylenenitrilo)) Tetraacetic Acid
Glycol ethers	Ethylene Glycol Bis(2,3-Epoxy-2-Methylpropyl) Ether
Glycol ethers	Ethylene Glycol Diallyl Ether
Glycol ethers	Ethylene Glycol Diethyl Ether
Glycol ethers	Ethylene Glycol dimethyl ether
Glycol ethers	Ethylene Glycol Methyl Ether
Glycol ethers	Ethylene Glycol Monobenzyl Ether
Glycol ethers	Ethylene Glycol Monomethyl Ether
Glycol ethers	Ethylene Glycol Monomethyl Ether Acetate

HAP List And Individual Constituents (Continued)

Glycol Ethers (Continued)	
188 Name	**Constituent**
Glycol ethers	Ethylene Glycol Mono-sec-Butyl Ether
Glycol ethers	Ethylene Glycol Monovinyl Ether
Glycol ethers	Ethyleneglycol Mono-2-Methylpentyl Ether
Glycol ethers	Ethyleneglycol Monophenyl Ether Propionate
Glycol ethers	Ethyleneglycolmono-2,6,8-Trimethyl-4-Nonyl Ether
Glycol ethers	Glycols, Polyethylene, Mono(1,1,3,3-Tetramethylbutylphenyl) Ether
Glycol ethers	Glycols, Polyethylene, Polypropylene Monobutyl Ether (nonionic)
Glycol ethers	Isobutyl Cellosolve
Glycol ethers	Isopropyl Glycol
Glycol ethers	Methoxyethyl Oleate
Glycol ethers	Methyl Cellosolve Acetylricinoleate
Glycol ethers	Methyl Cellosolve Acrylate
Glycol ethers	Nonyl Phenyl Polyethylene Glycol Ether
Glycol ethers	p-Dioxane
Glycol ethers	Propyl Cellosolve
Glycol ethers	Propylene Glycol Monomethyl Ether
Glycol ethers	Triethylene Glycol
Glycol ethers	Glycol Ethers

HAP List And Individual Constituents (Continued)

Dioxins and Furans*	
188 HAP Name	**Constituent**
Dioxins and Furans	Dibenzofuran
Dioxins and Furans	Octachlorodibenzo-p-dioxin
Dioxins and Furans	1,2,3,7,8,9-hexachlorodibenzo-p-dioxin
Dioxins and Furans	Hexachlorodibenzo-p-dioxin
Dioxins and Furans	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin
Dioxins and Furans	Octachlorodibenzofuran
Dioxins and Furans	1,2,3,4,7,8-hexachlorodibenzo-p-dioxin
Dioxins and Furans	1,2,3,7,8-pentachlorodibenzo-p-dioxin
Dioxins and Furans	2,3,7,8-Tetrachlorodibenzofuran
Dioxins and Furans	1,2,3,4,7,8,9-heptachlorodibenzofuran
Dioxins and Furans	2,3,4,7,8-pentachlorodibenzofuran
Dioxins and Furans	1,2,3,7,8-pentachlorodibenzofuran
Dioxins and Furans	1,2,3,6,7,8-hexachlorodibenzofuran
Dioxins and Furans	1,2,3,6,7,8-hexachlorodibenzo-p-dioxin
Dioxins and Furans	2,3,4,6,7,8-hexachlorodibenzofuran
Dioxins and Furans	1,2,3,4,6,7,8-heptachlorodibenzofuran
Dioxins and Furans	1,2,3,4,7,8-hexachlorodibenzofuran
Dioxins and Furans	1,2,3,7,8,9-hexachlorodibenzofuran
Dioxins and Furans	Dibenzofurans(Cl)
Dioxins and Furans	Dioxins
Dioxins and Furans	Heptachlorodibenzofuran
Dioxins and Furans	Heptachlorodibenzo-p-dioxin
Dioxins and Furans	Hexachlorodibenzofuran
Dioxins and Furans	Pentachlorodibenzofuran
Dioxins and Furans	Pentachlorodibenzo-p-dioxin
Dioxins and Furans	Tetrachlorodibenzofuran
Dioxins and Furans	Tetrachlorodibenzo-p-dioxin

*Dioxins and Furans (total tetra - through octa - chlorinated dibenzo-p-dioxins and dibenzofurans) are federally designated pollutants under the New Source Performance Standard (NSPS) program.

HAP List And Individual Constituents (Continued)

PAH/POM	
188 HAP Name	**Constituent**
Polycyclic Organic Matter	Benzo[a]pyrene
Polycyclic Organic Matter	Dibenzo[a,h]anthracene
Polycyclic Organic Matter	Benz[a]anthracene
Polycyclic Organic Matter	Acenaphthene
Polycyclic Organic Matter	Phenanthrene
Polycyclic Organic Matter	Fluorene
Polycyclic Organic Matter	1-methylnaphthalene
Polycyclic Organic Matter	2-Methylnaphthalene
Polycyclic Organic Matter	2-chloronaphthalene
Polycyclic Organic Matter	Anthracene
Polycyclic Organic Matter	Crotonaldehyde
Polycyclic Organic Matter	Pyrene
Polycyclic Organic Matter	D[a,h]pyrene
Polycyclic Organic Matter	Benzo[g,h,i,]perylene
Polycyclic Organic Matter	D[a,e]pyrene
Polycyclic Organic Matter	Benzo[e]pyrene
Polycyclic Organic Matter	Indeno[1,2,3-c,d]pyrene
Polycyclic Organic Matter	B[j]fluoranthen
Polycyclic Organic Matter	Benzo[b]fluoranthene
Polycyclic Organic Matter	Fluoranthene
Polycyclic Organic Matter	Benzo[k]fluoranthene
Polycyclic Organic Matter	Acenaphthylene
Polycyclic Organic Matter	Chrysene
Polycyclic Organic Matter	D[a,j]acridine
Polycyclic Organic Matter	16-PAH*
Polycyclic Organic Matter	1-Phenanthrene
Polycyclic Organic Matter	Acenaphthalene
Polycyclic Organic Matter	Benzo[b+k]fluoranthene
Polycyclic Organic Matter	PAH, total
Polycyclic Organic Matter	Polycyclic Organic Matter
Polycyclic Organic Matter	Extractable Organic Matter (EOM)
Polycyclic Organic Matter	7-PAH**

* 16 PAH compounds include:

Acenaphthene	Benzo(a)pyrene**	Chrysene**	Indeno(1,2,3-cd)pyrene**
Acenaphthylene	Benzo(b)fluoranthene**	Dibenz(a,h)anthracene**	Naphthalene
Anthracene	Benzo(ghi)perylene	Fluoranthene	Phenanthrene
Benz(a)anthracene**	Benzo(k)fluoranthene**	Fluorene	Pyrene

** These 7 PAHs are carcinogenic and are usually reported as the sum of 7 PAH.

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APPENDIX I

LIST OF HAZARDOUS AIR POLLUTANTS AND

ASSOCIATED MACT SOURCE CATEGORIES

[NOTE: These tables include only MACT source categories for which national-level HAP emission estimates have been developed under EPA's National Toxic Inventory Development Program; they do not include all HAP emissions from all MACT sources. Source: U.S. Environmental Protection Agency, 1998. *Baseline Emissions Inventory of HAP Emissions from MACT Sources*. Prepared by the Emission Factor and Inventory Group, Research Triangle Park, North Carolina.]

Hazardous Air Pollutants and Their Associated MACT Source Categories

1,1,2,2-Tetrachloroethane (79345)	
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
Hazardous Waste Incineration	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Medical Waste Incinerators	Secondary Lead Smelting
MON	Sewage Sludge Incineration
Municipal Landfills	Tire Production
Polymers & Resins (Excluding P&R III)	
1,1,2-Trichloroethane (79005)	
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Hazardous Waste Incineration	Pulp and Paper Production (non-combustion) MACT I
MON	Steel Foundries
Paper and Other Webs (Surface Coating)	Tire Production
Pharmaceuticals Production	Utilities - Coal
Portland Cement Manufacturing: Hazardous Waste-fired	
1,1-Dimethylhydrazine (57147)	
Chlorine Production	MON
	Polymers & Resins (Excluding P&R III)
1,2,4-Trichlorobenzene (120821)	
Agricultural Chemicals Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Chlorine Production	Pulp and Paper Production (non-combustion) MACT I
MON	Semiconductor Manufacturing
Portland Cement Manufacturing: Hazardous Waste-fired	Tire Production
1,2-Dibromo-3-chloropropane (96128)	
Tire Production	
1,2-Epoxybutane (106887)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
Pharmaceuticals Production	
1,2-Propylenimine (2-Methylaziridine) (75558)	
MON	Polymers & Resins (Excluding P&R III)
Pharmaceuticals Production	
1,3-Butadiene (106990)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Secondary Lead Smelting
Coke By-Product Plants	Stationary Internal Combustion Engines
MON	Tire Production
1,3-Dichloropropene (542756)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Secondary Lead Smelting
MON	Utilities - Coal
1,4-Dichlorobenzene (p) (106467)	
Agricultural Chemicals Production	MON

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Friction Products Manufacturing	Sewage Sludge Incineration
Industrial Boilers	Tire Production
1,4-Dioxane (1,4-Diethyleneoxide) (123911)	
Aerospace Industries	Paper and Other Webs (Surface Coating)
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Iron Foundries	Printing/Publishing (Surface Coating)
MON	Tire Production
2,2,4-trimethylpentane (540841)	
Gasoline Distribution (Stage 1)	Petroleum Refineries: Other Sources Not Distinctly Listed
Oil and Natural Gas Production	Tire Production
2,4,5-Trichlorophenol	
Tire Production	
2,4,6-Trichlorophenol (95954)	
Polymers & Resins (Excluding P&R III)	Tire Production
2,4-D (2,4-Dichlorophenoxyacetic Acid) (94757)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
MON	
2,4-Dinitrophenol (51285)	
Agricultural Chemicals Production	MON
Coke By-Product Plants	Polymers & Resins (Excluding P&R III)
Industrial Boilers	Steel Foundries
Institutional/Commercial Boilers	Tire Production
2,4-Dinitrotoluene (121142)	
Industrial Boilers	MON
Institutional/Commercial Boilers	Tire Production
	Utilities - Coal
2,4-Toluene Diisocyanate (584849)	
Clay Products Manufacturing	Polymers & Resins (Excluding P&R III)
Flexible Polyurethane Foam Production	Spandex Production
MON	Vegetable Oil Production
Paper and Other Webs (Surface Coating)	
2-Chloroacetophenone (532274)	
Industrial Boilers	Tire Production
Institutional/Commercial Boilers	Utilities - Coal
2-Nitropropane	
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Portland Cement Manufacturing: Hazardous Waste-fired	Printing/Publishing (Surface Coating)

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

3,3-Dichlorobenzidene (91941)	
MON	Tire Production
3,3-Dimethoxybenzidine (119904)	
Tire Production	
3,3'-Dimethylbenzidine (119934)	
Tire Production	
4,4-Methylenebis(2-chloroaniline) (101144)	
Polymers & Resins (Excluding P&R III)	Tire Production
4,4'-Methylenedianiline (101779)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Tire Production
4,6-Dinitro-o-cresol (including salts) (534521)	
Agricultural Chemicals Production	Tire Production
MON	
4,4'-Methylenedianiline (101779)	
Agricultural Chemicals Production	MON
Boat Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Flexible Polyurethane Foam Production	Printing/Publishing (Surface Coating)
Integrated Iron and Steel Manufacturing	Steel Foundries
Iron Foundries	Vegetable Oil Production
Mineral Wool Production	
4-Aminobiphenyl (92671)	
Tire Production	
Dimethylaminoazobenzene (60117)	
Tire Production	
4-Nitrobiphenyl (92933)	
Tire Production	
4-Nitrophenol (100027)	
Agricultural Chemicals Production	Institutional/Commercial Boilers
	MON
Industrial Boilers	Tire Production
Acetaldehyde (75070)	
Baker’s Yeast Manufacturing	Pulp and Paper Production (combustion) MACT II
Chlorine Production	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Sewage Sludge Incineration
MON	Stationary Internal Combustion Engines
Municipal Waste Combustors	Stationary Turbines
Other Biological Incineration	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Plywood/Particle Board Manufacturing	Utilities - Oil
Polymers & Resins (Excluding P&R III)	
Acetamide (60355)	
MON	
Acetonitrile (75058)	
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Sewage Sludge Incineration
Pharmaceuticals Production	Tire Production
Polymers & Resins (Excluding P&R III)	
Acetophenone (98862)	
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Tire Production
Pharmaceuticals Production	Utilities - Coal
Pulp and Paper Production (non-combustion) MACT I	
Acrolein (107028)	
Chlorine Production	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Stationary Internal Combustion Engines
MON	Tire Production
Polymers & Resins (Excluding P&R III)	Utilities - Coal
Acrylamide (79061)	
MON	Polymers & Resins (Excluding P&R III)
Paper and Other Webs (Surface Coating)	
Acrylic Acid (79107)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Printing/Publishing (Surface Coating)
Paper and Other Webs (Surface Coating)	
Acrylonitrile (107131)	
Acrylic Fibers/Modacrylic Fibers Production	Polymers & Resins (Excluding P&R III)
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
MON	Secondary Lead Smelting
Municipal Landfills	Sewage Sludge Incineration
Paper and Other Webs (Surface Coating)	Tire Production
Pharmaceuticals Production	
Allyl Chloride (107051)	
Chlorine Production	Polymers & Resins (Excluding P&R III)

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

MON	Tire Production
Pharmaceuticals Production	
Aniline (62533)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Tire Production
Pharmaceuticals Production	
Antimony & Compounds	
Agricultural Chemicals Production	Primary Copper Smelting
Asphalt Roofing Manufacturing	Primary Lead Smelting
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Coke By-Product Plants	Pulp and Paper Production (combustion) MACT II
Ferroalloys Production	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Semiconductor Manufacturing
Iron Foundries	Sewage Sludge Incineration
Medical Waste Incinerators	Steel Foundries
MON	Utilities - Coal
Paper and Other Webs (Surface Coating)	Utility Turbines
Polymers & Resins (Excluding P&R III)	
Arsenic & Compounds (inorganic including Arsine)	
Aerospace Industries	Primary Copper Smelting
Agricultural Chemicals Production	Primary Lead Smelting
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Crematories	Pulp and Paper Production (combustion) MACT II
Hazardous Waste Incineration	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Sewage Sludge Incineration
Iron Foundries	Steel Foundries
Medical Waste Incinerators	Utilities - Coal
MON	Utilities - Natural Gas
Municipal Waste Combustors	Utilities - Oil
Pharmaceuticals Production	Utility Turbines
Plywood/Particle Board Manufacturing	Wool Fiberglass Manufacturing
Asbestos (1332214)	
Asphalt Concrete Manufacturing	Chlorine Production
Asphalt Roofing Manufacturing	Paper and Other Webs (Surface Coating)
Benzene (71432)	
Aerospace Industries	Paper and Other Webs (Surface Coating)
Agricultural Chemicals Production	Petroleum Refineries: Other Sources Not Distinctly Listed
Asphalt Concrete Manufacturing	Pharmaceuticals Production

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Asphalt Roofing Manufacturing	Polymers & Resins (Excluding P&R III)
Carbon Black Production	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Coke By-Product Plants	Publicly Owned Treatment Works (POTW) Emissions
Coke Ovens: Charging, Top Side, and Door Leaks	Pulp and Paper Production (combustion) MACT II
Coke Ovens: Pushing, Quenching, and Battery Stacks	Pulp and Paper Production (non-combustion) MACT I
Gasoline Distribution (Stage 1)	Secondary Lead Smelting
Hazardous Waste Incineration	Sewage Sludge Incineration
Industrial Boilers	Stationary Internal Combustion Engines
Institutional/Commercial Boilers	Stationary Turbines
Integrated Iron and Steel Manufacturing	Steel Foundries
Iron Foundries	Taconite Iron Ore Processing
Marine Vessel Loading Operations	Tire Production
Medical Waste Incinerators	Utilities - Coal
MON	Utilities - Natural Gas
Municipal Landfills	Utilities - Oil
Oil and Natural Gas Production	Utility Turbines
Benzidine (92875)	
Tire Production	
Benzotrichloride (98077)	
Chlorine Production	Pulp and Paper Production (non-combustion) MACT I
MON	Tire Production
Benzyl Chloride (100447)	
Chlorine Production	Pharmaceuticals Production
Industrial Boilers	Polymers & Resins (Excluding P&R III)
Institutional/Commercial Boilers	Tire Production
MON	Utilities - Coal
Beryllium & Compounds	
Clay Products Manufacturing	Pulp and Paper Production (combustion) MACT II
Crematories	Sewage Sludge Incineration
Industrial Boilers	Steel Foundries
Institutional/Commercial Boilers	Utilities - Coal
Medical Waste Incinerators	Utilities - Oil
MON	Utility Boilers - Coke
Municipal Waste Combustors	Utility Turbines
Primary Copper Smelting	
Biphenyl (92524)	
Agricultural Chemicals Production	Pharmaceuticals Production
Carbon Black Production	Polymers & Resins (Excluding P&R III)

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Chlorine Production	Rayon Production
Coke By-Product Plants	Secondary Lead Smelting
MON	Steel Foundries
Paper and Other Webs (Surface Coating)	Tire Production
Petroleum Refineries: Other Sources Not Distinctly Listed	Vegetable Oil Production
Bis(2-ethylhexyl)phthalate (117817)	
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Asphalt Concrete Manufacturing	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Secondary Lead Smelting
Industrial Boilers	Sewage Sludge Incineration
Institutional/Commercial Boilers	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Pharmaceuticals Production	
Bis(chloromethyl) Ether (542881)	
MON	Polymers & Resins (Excluding P&R III)
Bromoform (75252)	
Industrial Boilers	Tire Production
Institutional/Commercial Boilers	Utilities - Coal
Cadmium & Compounds	
Aerospace Industries	Primary Lead Smelting
Carbon Black Production	Printing/Publishing (Surface Coating)
Clay Products Manufacturing	Pulp and Paper Production (combustion) MACT II
Crematories	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Sewage Sludge Incineration
Iron Foundries	Stationary Turbines
Medical Waste Incinerators	Steel Foundries
MON	Tire Production
Municipal Waste Combustors	Utilities - Coal
Other Biological Incineration	Utilities - Natural Gas
Paper and Other Webs (Surface Coating)	Utilities - Oil
Polymers & Resins (Excluding P&R III)	Utility Boilers - Coke
Primary Copper Smelting	Utility Turbines
Calcium Cyanamide (156627)	
MON	
Captan (133062)	
Agricultural Chemicals Production	MON
Carbaryl (63252)	
Agricultural Chemicals Production	MON

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Carbon Disulfide (75150)	
Agricultural Chemicals Production	Municipal Landfills
Carbon Black Production	Pharmaceuticals Production
Cellophane Production	Polymers & Resins (Excluding P&R III)
Cellulose Food Casing Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
Coke By-Product Plants	Pulp and Paper Production (non-combustion) MACT I
Coke Ovens: Pushing, Quenching, and Battery Stacks	Rayon Production
Friction Products Manufacturing	Secondary Lead Smelting
Industrial Boilers	Steel Foundries
Institutional/Commercial Boilers	Tire Production
MON	Utilities - Coal
Carbon Tetrachloride (56235)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Pulp and Paper Production (non-combustion) MACT I
Hazardous Waste Incineration	Sewage Sludge Incineration
Medical Waste Incinerators	Tire Production
MON	Utilities - Coal
Municipal Landfills	
Carbonyl Sulfide (463581)	
Carbon Black Production	Municipal Landfills
Chlorine Production	Polymers & Resins (Excluding P&R III)
Coke By-Product Plants	Primary Aluminum Production
Coke Ovens: Pushing, Quenching, and Battery Stacks	Steel Foundries
MON	Tire Production
Catechol (120809)	
MON	Semiconductor Manufacturing
Paper and Other Webs (Surface Coating)	
Chloramben (133904)	
Agricultural Chemicals Production	
Chlordane (57749)	
MON	
Chlorine (7782505)	
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Coke By-Product Plants	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Ferroalloys Production	Primary Aluminum Production

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Industrial Boilers	Primary Copper Smelting
Institutional/Commercial Boilers	Primary Magnesium Refining
Iron Foundries	Printing/Publishing (Surface Coating)
Leather Tanning and Finishing Operations	Pulp and Paper Production (non-combustion) MACT I
Medical Waste Incinerators	Rayon Production
MON	Semiconductor Manufacturing
Paper and Other Webs (Surface Coating)	Steel Foundries
Pharmaceuticals Production	Steel Pickling HCl Process
Phosphate Fertilizers Production	
Chloroacetic Acid (79118)	
MON	Polymers & Resins (Excluding P&R III)
Pharmaceuticals Production	
Chlorobenzene (108907)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Industrial Boilers	Pulp and Paper Production (non-combustion) MACT I
Institutional/Commercial Boilers	Secondary Lead Smelting
MON	Sewage Sludge Incineration
Municipal Landfills	Steel Foundries
Paper and Other Webs (Surface Coating)	Tire Production
Pharmaceuticals Production	Utilities - Coal
Chloroform (67663)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Hazardous Waste Incineration	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Industrial Boilers	Publicly Owned Treatment Works (POTW) Emissions
Institutional/Commercial Boilers	Pulp and Paper Production (non-combustion) MACT I
Medical Waste Incinerators	Secondary Lead Smelting
MON	Sewage Sludge Incineration
Municipal Landfills	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Chloromethyl Methyl Ether (107302)	
MON	Polymers & Resins (Excluding P&R III)
Pharmaceuticals Production	
Chloroprene	
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Chromium & Compounds	
Aerospace Industries	Municipal Waste Combustors
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Asphalt Roofing Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Chromic Acid Anodizing	Portland Cement Manufacturing: Hazardous Waste-fired
Chromium Refractories Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Primary Aluminum Production
Coke By-Product Plants	Primary Copper Smelting
Crematories	Printing/Publishing (Surface Coating)
Decorative Chromium Electroplating	Pulp and Paper Production (combustion) MACT II
Ferroalloys Production	Secondary Aluminum Production
Friction Products Manufacturing	Secondary Lead Smelting
Hard Chromium Electroplating	Sewage Sludge Incineration
Industrial Boilers	Stationary Turbines
Industrial Process Cooling Towers	Steel Foundries
Institutional/Commercial Boilers	Tire Production
Integrated Iron and Steel Manufacturing	Utilities - Coal
Iron Foundries	Utilities - Natural Gas
Leather Tanning and Finishing Operations	Utilities - Oil
Lime Manufacturing	Utility Boilers - Coke
Medical Waste Incinerators	Utility Turbines
Mineral Wool Production	Wool Fiberglass Manufacturing
MON	
Cobalt Compounds	
Aerospace Industries	Primary Copper Smelting
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Ferroalloys Production	Pulp and Paper Production (combustion) MACT II
Industrial Boilers	Sewage Sludge Incineration
Institutional/Commercial Boilers	Steel Foundries
Integrated Iron and Steel Manufacturing	Utilities - Coal
Iron Foundries	Utilities - Natural Gas
MON	Utilities - Oil
Paper and Other Webs (Surface Coating)	Utility Turbines
Polymers & Resins (Excluding P&R III)	
Coke Oven Emissions	
Coke Ovens: Charging, Top Side, and Door Leaks	
Cresols (1319773) (includes o [95487], m [108394], and p [106445])	
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Primary Copper Smelting
MON	Pulp and Paper Production (non-combustion) MACT I
Paper and Other Webs (Surface Coating)	Steel Foundries

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Petroleum Refineries: Other Sources Not Distinctly Listed	Tire Production
Polymers & Resins (Excluding P&R III)	Utilities - Coal
Cumene (98828)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Asphalt Concrete Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Gasoline Distribution (Stage 1)	Primary Aluminum Production
Industrial Boilers	Printing/Publishing (Surface Coating)
Institutional/Commercial Boilers	Pulp and Paper Production (non-combustion) MACT I
Iron Foundries	Secondary Lead Smelting
MON	Steel Foundries
Paper and Other Webs (Surface Coating)	Tire Production
Petroleum Refineries: Other Sources Not Distinctly Listed	Utilities - Coal
Pharmaceuticals Production	
Cyanide Compounds	
Agricultural Chemicals Production	MON
Carbon Black Production	Paper and Other Webs (Surface Coating)
Coke By-Product Plants	Pharmaceuticals Production
Ferroalloys Production	Primary Aluminum Production
Industrial Boilers	Printing/Publishing (Surface Coating)
Institutional/Commercial Boilers	Steel Foundries
Dibutyl Phthalate (84742)	
Asphalt Concrete Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Friction Products Manufacturing	Printing/Publishing (Surface Coating)
MON	Secondary Lead Smelting
Paper and Other Webs (Surface Coating)	Tire Production
Plywood/Particle Board Manufacturing	Utilities - Coal
Polymers & Resins (Excluding P&R III)	
Dichlorethyl Ether (111444)	
Chlorine Production	Tire Production
MON	
Dichlorvos (62737)	
Agricultural Chemicals Production	Pharmaceuticals Production
MON	
Diethanolamine (111422)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Iron Foundries	Portland Cement Manufacturing: Hazardous Waste-fired
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Paper and Other Webs (Surface Coating)	Steel Foundries
Diethyl Sulfate (64675)	
MON	Pharmaceuticals Production
Paper and Other Webs (Surface Coating)	Polymers & Resins (Excluding P&R III)
Dimethyl Phthalate (131113)	
Boat Manufacturing	Pharmaceuticals Production
Clay Products Manufacturing	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Dimethyl Sulfate (77781)	
Agricultural Chemicals Production	MON
Industrial Boilers	Paper and Other Webs (Surface Coating)
Institutional/Commercial Boilers	Pharmaceuticals Production
Dimethylformamide (68122)	
Pharmaceuticals Production	
Dioxin/Furans as 2,3,7,8-TCDD TEQ (1746016)	
Crematories	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Hazardous Waste Incineration	Pulp and Paper Production (combustion) MACT II
Industrial Boilers	Scrap or Waste Tire Incineration
Integrated Iron and Steel Manufacturing	Secondary Aluminum Production
Medical Waste Incinerators	Secondary Lead Smelting
Municipal Waste Combustors	Sewage Sludge Incineration
Other Biological Incineration	Utilities - Coal
Portland Cement Manufacturing: Hazardous Waste-fired	Utilities - Oil
Epichlorohydrin (l-Chloro-2,3-epoxypropane) (106898)	
Asphalt Concrete Manufacturing	Polymers & Resins (Excluding P&R III)
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Pharmaceuticals Production	Tire Production
Ethyl Acrylate (140885)	
Chlorine Production	Pharmaceuticals Production
MON	Polymers & Resins (Excluding P&R III)
Paper and Other Webs (Surface Coating)	
Ethyl Carbamate (51796)	
Secondary Lead Smelting	
Ethyl Chloride (75003)	
Chlorine Production	Pharmaceuticals Production
Industrial Boilers	Polycarbonates Production
Institutional/Commercial Boilers	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Municipal Landfills	Utilities - Coal

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Ethylbenzene (100414)	
Aerospace Industries	Petroleum Refineries: Other Sources Not Distinctly Listed
Agricultural Chemicals Production	Pharmaceuticals Production
Asphalt Concrete Manufacturing	Plywood/Particle Board Manufacturing
Asphalt Roofing Manufacturing	Polymers & Resins (Excluding P&R III)
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
Gasoline Distribution (Stage 1)	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Semiconductor Manufacturing
Iron Foundries	Sewage Sludge Incineration
Mineral Wool Production	Steel Foundries
MON	Tire Production
Municipal Landfills	Utilities - Coal
Oil and Natural Gas Production	Utilities - Oil
Paper and Other Webs (Surface Coating)	
Ethylene Dibromide (106934)	
Industrial Boilers	Pharmaceuticals Production
Institutional/Commercial Boilers	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Ethylene Dichloride (75343)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Chlorine Production	Pharmaceuticals Production
Gasoline Distribution (Stage 1)	Polymers & Resins (Excluding P&R III)
Industrial Boilers	Portland Cement Manufacturing: Hazardous Waste-fired
Institutional/Commercial Boilers	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Medical Waste Incinerators	Pulp and Paper Production (non-combustion) MACT I
MON	Sewage Sludge Incineration
Municipal Landfills	Tire Production
Other Biological Incineration	Utilities - Coal
Ethylene Glycol (107211)	
Agricultural Chemicals Production	Metal Coil (Surface Coating)
Asphalt Concrete Manufacturing	Metal Furniture (Surface Coating)
Asphalt Roofing Manufacturing	Mineral Wool Production
Auto and Light Duty Truck (Surface Coating)	Miscellaneous Metal Parts and Products (Surface Coating)
Carbon Black Production	MON
Chlorine Production	Paper and Other Webs (Surface Coating)
Chromium Refractories Production	Pharmaceuticals Production
Clay Products Manufacturing	Plywood/Particle Board Manufacturing
Coke By-Product Plants	Polymers & Resins (Excluding P&R III)

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Ferroalloys Production	Portland Cement Manufacturing: Hazardous Waste-fired
Flat Wood Paneling (Surface Coating)	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Friction Products Manufacturing	Primary Aluminum Production
Integrated Iron and Steel Manufacturing	Printing/Publishing (Surface Coating)
Iron Foundries	Rayon Production
Large Appliance (Surface Coating)	Semiconductor Manufacturing
Metal Can (Surface Coating)	Steel Foundries
Ethylene Oxide (75218)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Chlorine Production	Pharmaceuticals Production
Commercial Sterilization Facilities	Polyether Polyols Production
MON	Polymers & Resins (Excluding P&R III)
Ethylidene Dichloride (75343)	
Municipal Landfills	Tire Production
Formaldehyde (50000)	
Aerospace Industries	Polymers and Resins III
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
Asphalt Roofing Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Chlorine Production	Printing/Publishing (Surface Coating)
Chromium Refractories Production	Pulp and Paper Production (combustion) MACT II
Crematories	Pulp and Paper Production (non-combustion) MACT I
Friction Products Manufacturing	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Sewage Sludge Incineration
Iron Foundries	Stationary Internal Combustion Engines
Leather Tanning and Finishing Operations	Stationary Turbines
Medical Waste Incinerators	Steel Foundries
Mineral Wool Production	Taconite Iron Ore Processing
MON	Utilities - Coal
Municipal Waste Combustors	Utilities - Natural Gas
Paper and Other Webs (Surface Coating)	Utilities - Oil
Pharmaceuticals Production	Utility Turbines
Plywood/Particle Board Manufacturing	Wool Fiberglass Manufacturing
Polymers & Resins (Excluding P&R III)	
Glycol Ethers	
Aerospace Industries	MON
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Asphalt Roofing Manufacturing	Pharmaceuticals Production
Auto and Light Duty Truck (Surface Coating)	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Coke By-Product Plants	Portland Cement Manufacturing: Non-Hazardous Waste-fired

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Flat Wood Paneling (Surface Coating)	Primary Aluminum Production
Friction Products Manufacturing	Printing/Publishing (Surface Coating)
Iron Foundries	Publicly Owned Treatment Works (POTW) Emissions
Large Appliance (Surface Coating)	Rayon Production
Leather Tanning and Finishing Operations	Semiconductor Manufacturing
Metal Can (Surface Coating)	Shipbuilding and Ship Repair (Surface Coating)
Metal Coil (Surface Coating)	Steel Foundries
Metal Furniture (Surface Coating)	Wood Furniture (Surface Coating)
Miscellaneous Metal Parts and Products (Surface Coating)	
Heptachlor (76448)	
MON	
Hexachlorobenzene (118741)	
Agricultural Chemicals Production	Tire Production
MON	Utilities - Coal
Hexachlorobutadiene (87683)	
Chlorine Production	Tire Production
MON	
Hexachlorocyclopentadiene (77474)	
Agricultural Chemicals Production	MON
Chlorine Production	Tire Production
Hexachloroethane (67721)	
Agricultural Chemicals Production	MON
Chlorine Production	Tire Production
Hexane (110543)	
Aerospace Industries	Petroleum Refineries: Other Sources Not Distinctly Listed
Gasoline Distribution (Stage 1)	Pharmaceuticals Production
Industrial Boilers	Polyether Polyols Production
Institutional/Commercial Boilers	Pulp and Paper Production (non-combustion) MACT I
Marine Vessel Loading Operations	Secondary Lead Smelting
Municipal Landfills	Tire Production
Oil and Natural Gas Production	Utilities - Coal
Hydrazine (302012)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	
Hydrochloric Acid (Hydrogen Chloride [gas only]) (7647010)	
Agricultural Chemicals Production	Phosphate Fertilizers Production
Asphalt Concrete Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Coke By-Product Plants	Primary Aluminum Production
Ferroalloys Production	Primary Copper Smelting
Friction Products Manufacturing	Primary Magnesium Refining
Hazardous Waste Incineration	Printing/Publishing (Surface Coating)
Industrial Boilers	Pulp and Paper Production (combustion) MACT II
Integrated Iron and Steel Manufacturing	Pulp and Paper Production (non-combustion) MACT I
Iron Foundries	Secondary Aluminum Production
Leather Tanning and Finishing Operations	Semiconductor Manufacturing
Lime Manufacturing	Sewage Sludge Incineration
Medical Waste Incinerators	Steel Foundries
MON	Steel Pickling HCl Process
Municipal Waste Combustors	Utilities - Coal
Paper and Other Webs (Surface Coating)	Utilities - Oil
Pharmaceuticals Production	Vegetable Oil Production
Hydrogen Fluoride (Hydrofluoric Acid) (7664393)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Chlorine Production	Phosphate Fertilizers Production
Chromium Refractories Production	Phosphoric Acid Manufacturing
Clay Products Manufacturing	Polymers & Resins (Excluding P&R III)
Ferroalloys Production	Primary Aluminum Production
Friction Products Manufacturing	Secondary Aluminum Production
Hydrogen Fluoride Production	Semiconductor Manufacturing
Integrated Iron and Steel Manufacturing	Steel Foundries
Iron Foundries	Utilities - Coal
Medical Waste Incinerators	Utilities - Oil
MON	
Hydroquinone (123319)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Semiconductor Manufacturing
Paper and Other Webs (Surface Coating)	Tire Production
Isophorone (78591)	
Clay Products Manufacturing	Tire Production
Industrial Boilers	Utilities - Coal
Institutional/Commercial Boilers	
Lead & Compounds	
Aerospace Industries	Polymers & Resins (Excluding P&R III)
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
Asphalt Concrete Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Auto and Light Duty Truck (Surface Coating)	Primary Aluminum Production
Boat Manufacturing	Primary Copper Smelting
Clay Products Manufacturing	Primary Lead Smelting

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Coke By-Product Plants	Printing/Publishing (Surface Coating)
Ferroalloys Production	Pulp and Paper Production (combustion) MACT II
Friction Products Manufacturing	Secondary Aluminum Production
Gasoline Distribution (Stage 1)	Secondary Lead Smelting
Industrial Boilers	Semiconductor Manufacturing
Institutional/Commercial Boilers	Sewage Sludge Incineration
Integrated Iron and Steel Manufacturing	Steel Foundries
Iron Foundries	Taconite Iron Ore Processing
Lime Manufacturing	Tire Production
Medical Waste Incinerators	Utilities - Coal
MON	Utilities - Natural Gas
Municipal Waste Combustors	Utilities - Oil
Paper and Other Webs (Surface Coating)	Utility Turbines
Phosphate Fertilizers Production	Wool Fiberglass Manufacturing
Lindane (58899)	
Agricultural Chemicals Production	
Maleic Anhydride (108316)	
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Printing/Publishing (Surface Coating)
Pharmaceuticals Production	Vegetable Oil Production
Polymers & Resins (Excluding P&R III)	
Manganese & Compounds	
Agricultural Chemicals Production	Phosphate Fertilizers Production
Boat Manufacturing	Polymers & Resins (Excluding P&R III)
Chlorine Production	Primary Aluminum Production
Clay Products Manufacturing	Primary Copper Smelting
Coke By-Product Plants	Primary Lead Smelting
Ferroalloys Production	Pulp and Paper Production (combustion) MACT II
Friction Products Manufacturing	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Semiconductor Manufacturing
Integrated Iron and Steel Manufacturing	Sewage Sludge Incineration
Iron Foundries	Stationary Turbines
Medical Waste Incinerators	Steel Foundries
MON	Utilities - Coal
Municipal Waste Combustors	Utilities - Natural Gas
Paper and Other Webs (Surface Coating)	Utilities - Oil
Pharmaceuticals Production	Utility Turbines
Mercury & Compounds	
Aerospace Industries	Portland Cement Manufacturing: Hazardous Waste-fired
Carbon Black Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Chlorine Production	Primary Copper Smelting
Chromic Acid Anodizing	Primary Lead Smelting
Clay Products Manufacturing	Pulp and Paper Production (combustion) MACT II
Crematories	Secondary Aluminum Production
Hazardous Waste Incineration	Secondary Lead Smelting
Industrial Boilers	Sewage Sludge Incineration
Institutional/Commercial Boilers	Stationary Internal Combustion Engines
Lime Manufacturing	Stationary Turbines
Medical Waste Incinerators	Steel Foundries
MON	Utilities - Coal
Municipal Waste Combustors	Utilities - Natural Gas
Polymers & Resins (Excluding P&R III)	Utilities - Oil
	Utility Turbines
Methanol (67561)	
Aerospace Industries	Plywood/Particle Board Manufacturing
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Polymers and Resins III
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
Integrated Iron and Steel Manufacturing	Pulp and Paper Production (combustion) MACT II
Iron Foundries	Pulp and Paper Production (non-combustion) MACT I
Leather Tanning and Finishing Operations	Rayon Production
Mineral Wool Production	Semiconductor Manufacturing
MON	Steel Foundries
Paper and Other Webs (Surface Coating)	Vegetable Oil Production
Pharmaceuticals Production	Wool Fiberglass Manufacturing
Phosphate Fertilizers Production	
Methoxychlor (72435)	
Agricultural Chemicals Production	
Methyl Bromide (Bromomethane) (74839)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Clay Products Manufacturing	Polymers & Resins (Excluding P&R III)
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Tire Production
MON	Utilities - Coal
Methyl Chloride (74873)	
Aerospace Industries	Pharmaceuticals Production
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Pulp and Paper Production (non-combustion) MACT I
Clay Products Manufacturing	Secondary Lead Smelting

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Industrial Boilers	Tire Production
MON	Utilities - Coal
Methyl Chloroform (1,1,1-Trichloroethane) (71556)	
Aerospace Industries	Municipal Landfills
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Asphalt Concrete Manufacturing	Pharmaceuticals Production
Asphalt Roofing Manufacturing	Phosphate Fertilizers Production
Boat Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Ferroalloys Production	Primary Aluminum Production
Friction Products Manufacturing	Primary Copper Smelting
Halogenated Solvent Cleaners	Printing/Publishing (Surface Coating)
Hazardous Waste Incineration	Publicly Owned Treatment Works (POTW) Emissions
Industrial Boilers	Pulp and Paper Production (non-combustion) MACT I
Institutional/Commercial Boilers	Semiconductor Manufacturing
Integrated Iron and Steel Manufacturing	Sewage Sludge Incineration
Iron Foundries	Steel Foundries
Medical Waste Incinerators	Tire Production
Mineral Wool Production	Utilities - Coal
MON	Utilities - Oil
Methyl Ethyl Ketone (2-Butanone) (78933)	
Aerospace Industries	Paper and Other Webs (Surface Coating)
Auto and Light Duty Truck (Surface Coating)	Pharmaceuticals Production
Boat Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Flat Wood Paneling (Surface Coating)	Primary Aluminum Production
Friction Products Manufacturing	Printing/Publishing (Surface Coating)
Industrial Boilers	Publicly Owned Treatment Works (POTW) Emissions
Institutional/Commercial Boilers	Pulp and Paper Production (combustion) MACT II
Integrated Iron and Steel Manufacturing	Pulp and Paper Production (non-combustion) MACT I
Iron Foundries	Secondary Lead Smelting
Large Appliance (Surface Coating)	Semiconductor Manufacturing
Leather Tanning and Finishing Operations	Sewage Sludge Incineration
Magnetic Tape (Surface Coating)	Shipbuilding and Ship Repair (Surface Coating)
Metal Can (Surface Coating)	Steel Foundries
Metal Coil (Surface Coating)	Tire Production
Metal Furniture (Surface Coating)	Utilities - Coal

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Miscellaneous Metal Parts and Products (Surface Coating)	Vegetable Oil Production
MON	Wood Furniture (Surface Coating)
Municipal Landfills	
Methyl Iodide (Iodomethane) (74884)	
Clay Products Manufacturing	Secondary Lead Smelting
MON	Utilities - Coal
Pharmaceuticals Production	
Methyl Isobutyl Ketone (Hexone) (108101)	
Aerospace Industries	Paper and Other Webs (Surface Coating)
Agricultural Chemicals Production	Pharmaceuticals Production
Asphalt Roofing Manufacturing	Phosphate Fertilizers Production
Auto and Light Duty Truck (Surface Coating)	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Coke By-Product Plants	Portland Cement Manufacturing: Hazardous Waste-fired
Flat Wood Paneling (Surface Coating)	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Friction Products Manufacturing	Primary Aluminum Production
Integrated Iron and Steel Manufacturing	Printing/Publishing (Surface Coating)
Iron Foundries	Publicly Owned Treatment Works (POTW) Emissions
Leather Tanning and Finishing Operations	Pulp and Paper Production (combustion) MACT II
Magnetic Tape (Surface Coating)	Pulp and Paper Production (non-combustion) MACT I
Metal Can (Surface Coating)	Semiconductor Manufacturing
Metal Coil (Surface Coating)	Shipbuilding and Ship Repair (Surface Coating)
Metal Furniture (Surface Coating)	Steel Foundries
Miscellaneous Metal Parts and Products (Surface Coating)	Tire Production
MON	Utilities - Coal
Municipal Landfills	Wood Furniture (Surface Coating)
Methyl Isocyanate (624839)	
Agricultural Chemicals Production	MON
Iron Foundries	Plywood/Particle Board Manufacturing
Methyl Methacrylate (80626)	
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Boat Manufacturing	Polymers & Resins (Excluding P&R III)
Industrial Boilers	Portland Cement Manufacturing: Hazardous Waste-fired
Institutional/Commercial Boilers	Portland Cement Manufacturing: Non-Hazardous Waste-fired
MON	Utilities - Coal
Paper and Other Webs (Surface Coating)	
Methyl tert-Butyl Ether (1634044)	
Gasoline Distribution (Stage 1)	Pharmaceuticals Production
Industrial Boilers	Polymers & Resins (Excluding P&R III)
Institutional/Commercial Boilers	Tire Production

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

MON	Utilities - Coal
Petroleum Refineries: Other Sources Not Distinctly Listed	
Methylene Chloride (75092)	
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Boat Manufacturing	Polycarbonates Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Flexible Polyurethane Foam Fabrication Operations	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Flexible Polyurethane Foam Production	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
Halogenated Solvent Cleaners	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Semiconductor Manufacturing
Iron Foundries	Sewage Sludge Incineration
Medical Waste Incinerators	Spandex Production
MON	Steel Foundries
Municipal Landfills	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Pharmaceuticals Production	Utilities - Oil
Methylhydrazine (60344)	
Industrial Boilers	MON
Institutional/Commercial Boilers	
N,N-Dimethylaniline (121697)	
MON	Polymers & Resins (Excluding P&R III)
Paper and Other Webs (Surface Coating)	Tire Production
Pharmaceuticals Production	
N-Nitrosodimethylamine (62759)	
Pharmaceuticals Production	Utilities - Coal
Tire Production	
N-Nitrosomorpholine (59892)	
Tire Production	
Nickel & Compounds	
Aerospace Industries	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Chromium Refractories Production	Primary Aluminum Production
Clay Products Manufacturing	Primary Copper Smelting
Coke By-Product Plants	Primary Lead Smelting
Crematories	Printing/Publishing (Surface Coating)
Ferroalloys Production	Pulp and Paper Production (combustion) MACT II
Friction Products Manufacturing	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Institutional/Commercial Boilers	Sewage Sludge Incineration
Integrated Iron and Steel Manufacturing	Stationary Turbines
Iron Foundries	Steel Foundries
Medical Waste Incinerators	Tire Production
MON	Utilities - Coal
Municipal Waste Combustors	Utilities - Natural Gas
Paper and Other Webs (Surface Coating)	Utilities - Oil
Pharmaceuticals Production	Utility Boilers - Coke
Polymers & Resins (Excluding P&R III)	Utility Turbines
Portland Cement Manufacturing: Hazardous Waste-fired	Vegetable Oil Production
Nitrobenzene (98953)	
MON	Portland Cement Manufacturing: Hazardous Waste-fired
Pharmaceuticals Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Polymers & Resins (Excluding P&R III)	Tire Production
o-Anisidine (90040)	
MON	Tire Production
o-Toluidine (95534)	
Polymers & Resins (Excluding P&R III)	Tire Production
p-Phenylenediamine (106503)	
MON	Tire Production
Polymers & Resins (Excluding P&R III)	
Parathion (56382)	
Agricultural Chemicals Production	
Pentachloronitrobenzene (Quintobenzene) (82688)	
Agricultural Chemicals Production	Tire Production
MON	
Pentachlorophenol (87865)	
Agricultural Chemicals Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Plywood/Particle Board Manufacturing	Tire Production
Portland Cement Manufacturing: Hazardous Waste-fired	Utilities - Coal
Phenol (108952)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Polymers and Resins III
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Pulp and Paper Production (combustion) MACT II
Industrial Boilers	Pulp and Paper Production (non-combustion) MACT I
Institutional/Commercial Boilers	Secondary Lead Smelting
Integrated Iron and Steel Manufacturing	Semiconductor Manufacturing

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Iron Foundries	Sewage Sludge Incineration
Lime Manufacturing	Stationary Turbines
Mineral Wool Production	Steel Foundries
MON	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Petroleum Refineries: Other Sources Not Distinctly Listed	Utilities - Oil
Pharmaceuticals Production	Wool Fiberglass Manufacturing
Plywood/Particle Board Manufacturing	
Phosgene (75445)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	
Phosphorus (7723140)	
Clay Products Manufacturing	Steel Foundries
Industrial Boilers	Utilities - Coal
MON	Utilities - Natural Gas
Phosphate Fertilizers Production	Utilities - Oil
Sewage Sludge Incineration	Utility Turbines
Phthalic Anhydride (85449)	
MON	Portland Cement Manufacturing: Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Pharmaceuticals Production	Printing/Publishing (Surface Coating)
Polymers & Resins (Excluding P&R III)	Utilities - Coal
Polychlorinated Biphenyls (Aroclors) (1336363)	
Hazardous Waste Incineration	Other Biological Incineration
Industrial Boilers	Scrap or Waste Tire Incineration
Medical Waste Incinerators	Sewage Sludge Incineration
Municipal Landfills	Utilities - Oil
Municipal Waste Combustors	
Polycyclic Organic Matter as 16-PAH	
Aerospace Industries	Municipal Waste Combustors
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Asphalt Concrete Manufacturing	Petroleum Refineries Catalytic Cracking (Fluid and other) Units, Catalytic Reforming Units, and Sulfur Plant Units
Asphalt Roofing Manufacturing	Petroleum Refineries: Other Sources Not Distinctly Listed
Carbon Black Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Coke By-Product Plants	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke Ovens: Charging, Top Side, and Door Leaks	Primary Aluminum Production

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Coke Ovens: Pushing, Quenching, and Battery Stacks	Printing/Publishing (Surface Coating)
Crematories	Pulp and Paper Production (combustion) MACT II
Ferroalloys Production	Scrap or Waste Tire Incineration
Friction Products Manufacturing	Secondary Lead Smelting
Gasoline Distribution (Stage 1)	Sewage Sludge Incineration
Hazardous Waste Incineration	Stationary Internal Combustion Engines
Industrial Boilers	Stationary Turbines
Institutional/Commercial Boilers	Steel Foundries
Integrated Iron and Steel Manufacturing	Tire Production
Iron Foundries	Utilities - Coal
Medical Waste Incinerators	Utilities - Natural Gas
MON	Utilities - Oil
Municipal Landfills	
Propionaldehyde (123386)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
Industrial Boilers	Pulp and Paper Production (non-combustion) MACT I
Institutional/Commercial Boilers	Secondary Lead Smelting
MON	Utilities - Coal
Propoxur (Baygon) (114261)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Propylene Dichloride (78875)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Municipal Landfills	
Propylene Oxide (75569)	
Agricultural Chemicals Production	Polyether Polyols Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Portland Cement Manufacturing: Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Pharmaceuticals Production	Tire Production
Quinoline (91225)	
Coke By-Product Plants	Steel Foundries
MON	Utilities - Coal
Pharmaceuticals Production	
Quinone (p-Benzoquinone) (106514)	
MON	
Selenium Compounds	
Industrial Boilers	Pulp and Paper Production (combustion) MACT II
Institutional/Commercial Boilers	Sewage Sludge Incineration
MON	Steel Foundries

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Paper and Other Webs (Surface Coating)	Utilities - Coal
Pharmaceuticals Production	Utilities - Oil
Primary Copper Smelting	Utility Turbines
Styrene (100425)	
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Asphalt Concrete Manufacturing	Polymers & Resins (Excluding P&R III)
Boat Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Primary Copper Smelting
Coke By-Product Plants	Publicly Owned Treatment Works (POTW) Emissions
Industrial Boilers	Pulp and Paper Production (combustion) MACT II
Institutional/Commercial Boilers	Pulp and Paper Production (non-combustion) MACT I
Iron Foundries	Secondary Lead Smelting
Mineral Wool Production	Steel Foundries
MON	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Petroleum Refineries: Other Sources Not Distinctly Listed	
Styrene Oxide (96093)	
MON	
Tetrachloroethylene (127184)	
Aerospace Industries	Pharmaceuticals Production
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Coke By-Product Plants	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Dry Cleaning Facilities	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
Halogenated Solvent Cleaners	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Semiconductor Manufacturing
Institutional/Commercial Boilers	Sewage Sludge Incineration
Leather Tanning and Finishing Operations	Steel Foundries
Medical Waste Incinerators	Tire Production
MON	Utilities - Coal
Municipal Landfills	Utilities - Oil
Paper and Other Webs (Surface Coating)	
Titanium Tetrachloride (7550450)	
MON	Polymers & Resins (Excluding P&R III)
Toluene (108883)	
Aerospace Industries	Oil and Natural Gas Production
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Asphalt Concrete Manufacturing	Petroleum Refineries: Other Sources Not Distinctly Listed

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Asphalt Roofing Manufacturing	Pharmaceuticals Production
Auto and Light Duty Truck (Surface Coating)	Phosphate Fertilizers Production
Boat Manufacturing	Plywood/Particle Board Manufacturing
Cellophane Production	Polyether Polyols Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Primary Aluminum Production
Coke Ovens: Pushing, Quenching, and Battery Stacks	Printing/Publishing (Surface Coating)
Flat Wood Paneling (Surface Coating)	Publicly Owned Treatment Works (POTW) Emissions
Friction Products Manufacturing	Pulp and Paper Production (combustion) MACT II
Gasoline Distribution (Stage 1)	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Semiconductor Manufacturing
Integrated Iron and Steel Manufacturing	Sewage Sludge Incineration
Iron Foundries	Shipbuilding and Ship Repair (Surface Coating)
Large Appliance (Surface Coating)	Spandex Production
Leather Tanning and Finishing Operations	Stationary Internal Combustion Engines
Magnetic Tape (Surface Coating)	Stationary Turbines
Marine Vessel Loading Operations	Steel Foundries
Medical Waste Incinerators	Taconite Iron Ore Processing
Metal Can (Surface Coating)	Tire Production
Metal Coil (Surface Coating)	Utilities - Coal
Metal Furniture (Surface Coating)	Utilities - Natural Gas
Mineral Wool Production	Utilities - Oil
Miscellaneous Metal Parts and Products (Surface Coating)	Vegetable Oil Production
MON	Wood Furniture (Surface Coating)
Municipal Landfills	
Trichloroethylene (79016)	
Aerospace Industries	Plywood/Particle Board Manufacturing
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Asphalt Roofing Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Coke By-Product Plants	Publicly Owned Treatment Works (POTW) Emissions
Halogenated Solvent Cleaners	Pulp and Paper Production (non-combustion) MACT I
Integrated Iron and Steel Manufacturing	Secondary Lead Smelting
Iron Foundries	Semiconductor Manufacturing
Medical Waste Incinerators	Sewage Sludge Incineration
MON	Steel Foundries

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Municipal Landfills	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Pharmaceuticals Production	
Triethylamine (121448)	
Pharmaceuticals Production	
Trifluralin (1582098)	
Agricultural Chemicals Production	Pharmaceuticals Production
MON	Tire Production
Vinyl Acetate (108054)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Industrial Boilers	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Institutional/Commercial Boilers	Printing/Publishing (Surface Coating)
Mineral Wool Production	Tire Production
MON	Utilities - Coal
Paper and Other Webs (Surface Coating)	Utilities - Oil
Pharmaceuticals Production	
Vinyl Bromide (593602)	
MON	Polymers & Resins (Excluding P&R III)
Vinyl Chloride (75014)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Chlorine Production	Polymers & Resins (Excluding P&R III)
Hazardous Waste Incineration	Sewage Sludge Incineration
MON	Tire Production
Municipal Landfills	
Vinylidene Chloride (75354)	
Chlorine Production	Pharmaceuticals Production
MON	Polymers & Resins (Excluding P&R III)
Municipal Landfills	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Xylenes (1330207) (includes o [95476), m [108383], and p [106423])	
Aerospace Industries	Municipal Landfills
Agricultural Chemicals Production	Oil and Natural Gas Production
Asphalt Concrete Manufacturing	Paper and Other Webs (Surface Coating)
Asphalt Roofing Manufacturing	Petroleum Refineries: Other Sources Not Distinctly Listed
Auto and Light Duty Truck (Surface Coating)	Pharmaceuticals Production
Boat Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Polymers and Resins III
Coke By-Product Plants	Portland Cement Manufacturing: Hazardous Waste-fired
Flat Wood Paneling (Surface Coating)	Portland Cement Manufacturing: Non-Hazardous Waste-fired

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Friction Products Manufacturing	Primary Aluminum Production
Gasoline Distribution (Stage 1)	Printing/Publishing (Surface Coating)
Industrial Boilers	Publicly Owned Treatment Works (POTW) Emissions
Institutional/Commercial Boilers	Pulp and Paper Production (combustion) MACT II
Integrated Iron and Steel Manufacturing	Pulp and Paper Production (non-combustion) MACT I
Iron Foundries	Secondary Lead Smelting
Large Appliance (Surface Coating)	Semiconductor Manufacturing
Leather Tanning and Finishing Operations	Sewage Sludge Incineration
Marine Vessel Loading Operations	Shipbuilding and Ship Repair (Surface Coating)
Medical Waste Incinerators	Stationary Internal Combustion Engines
Metal Can (Surface Coating)	Stationary Turbines
Metal Coil (Surface Coating)	Steel Foundries
Metal Furniture (Surface Coating)	Tire Production
Mineral Wool Production	Utilities - Oil
Miscellaneous Metal Parts and Products (Surface Coating)	Vegetable Oil Production
MON	Wood Furniture (Surface Coating)

APPENDIX J

LIST OF MACT SOURCE CATEGORIES AND ASSOCIATED HAZARDOUS AIR POLLUTANTS

[NOTE: These tables include only MACT source categories for which National-level HAP emission estimates have been developed under EPA's National Toxic Inventory Development Program; these do not include all HAP emissions from all MACT sources. Source: U.S. Environmental Protection Agency, 1998. *Baseline Emissions Inventory of HAP Emissions from MACT Sources*. Prepared by the Emission Factor and Inventory Group, Research Triangle Park, North Carolina.]

List of MACT Source Categories and Associated Hazardous Air Pollutants

MACT SOURCE CATEGORY

Acrylic Fibers/Modacrylic Fibers Production

Acrylonitrile

Aerospace Industries

1,4-Dioxane (1,4-Diethyleneoxide)
Arsenic & Compounds (inorganic including Arsine)
Benzene
Cadmium & Compounds
Chromium & Compounds
Cobalt Compounds
Ethylbenzene
Formaldehyde
Glycol Ethers
Hexane
Lead & Compounds
Mercury & Compounds
Methanol
Methyl Chloride
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Ethyl Ketone (2-Butanone)
Methyl Isobutyl Ketone (Hexone)
Nickel & Compounds
Polycyclic Organic Matter as 16-PAH
Tetrachloroethylene
Toluene
Trichloroethylene
Xylenes (includes o, m, and p)

Agricultural Chemicals Production

1,2,4-Trichlorobenzene
1,3-Butadiene
1,3-Dichloropropene
1,4-Dichlorobenzene
1,4-Dioxane (1,4-Diethyleneoxide)
2,4-D (2,4-Dichlorophenoxyacetic Acid)
2,4-Dinitrophenol
4,6-Dinitro-o-cresol (including salts)
4-4'-Methylenediphenyl Diisocyanate
4-Nitrophenol
Acetonitrile
Acrylic Acid
Acrylonitrile
Aniline
Antimony & Compounds
Arsenic & Compounds (inorganic including Arsine)
Benzene
Biphenyl
Bis(2-ethylhexyl)phthalate
Captan
Carbaryl
Chlorobenzene
Chloroform
Chromium & Compounds
Cresols (includes o,m,p)
Cumene
Cyanide Compounds
Dichlorvos
Diethanolamine
Dimethyl Sulfate
Ethylbenzene
Ethylene Dichloride
Ethylene Glycol
Ethylene Oxide
Formaldehyde
Glycol Ethers
Hexachlorobenzene
Hexachlorocyclopentadiene
Hexachloroethane
Hydrazine
Hydrochloric Acid (Hydrogen Chloride [gas only])
Hydrogen Fluoride (Hydrofluoric Acid)
Methanol
Methoxychlor
Methyl Bromide (Bromomethane)
Methyl Chloride
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Isobutyl Ketone (Hexone)
Methyl Isocyanate
Methyl Methacrylate
Methylene Chloride
Parathion
Pentachloronitrobenzene (Quintobenzene)
Pentachlorophenol
Phenol
Phosgene
Polycyclic Organic Matter as 16-PAH
Propoxur (Baygon)
Propylene Dichloride
Propylene Oxide
Styrene
Tetrachloroethylene
Toluene

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Carbon Disulfide	Lead & Compounds	Trichloroethylene
Carbon Tetrachloride	Lindane	Trifluralin
Chloramben	Maleic Anhydride	Vinyl Chloride
Chlorine	Manganese & Compounds	Xylenes (includes o, m, and p)

Asphalt Concrete Manufacturing

Asbestos	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Methyl Chloroform (1,1,1-Trichloroethane)
Benzene	Ethylbenzene	Polycyclic Organic Matter as 16-PAH
Bis(2-ethylhexyl)phthalate	Ethylene Glycol	Styrene
Cumene	Hydrochloric Acid (Hydrogen Chloride [gas only])	Toluene
Dibutyl Phthalate	Lead & Compounds	Xylenes (includes o, m, and p)

Asphalt Roofing Manufacturing

Antimony & Compounds	Ethylene Glycol	Polycyclic Organic Matter as 16-PAH
Asbestos	Formaldehyde	Toluene
Benzene	Glycol Ethers	Trichloroethylene
Chromium & Compounds	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)
Ethylbenzene	Methyl Isobutyl Ketone (Hexone)	

Auto and Light Duty Truck (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	
Lead & Compounds	Toluene	

Baker's Yeast Manufacturing

Acetaldehyde

Boat Manufacturing

4-4'-Methylenediphenyl Diisocyanate	Methyl Chloroform (1,1,1-Trichloroethane)	Styrene
Dimethyl Phthalate	Methyl Ethyl Ketone (2-Butanone)	Toluene
Lead & Compounds	Methyl Methacrylate	Xylenes (includes o, m, and p)
Manganese & Compounds	Methylene Chloride	

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Carbon Black Production

Benzene	Carbon Disulfide	Ethylene Glycol
Biphenyl	Carbonyl Sulfide	Mercury & Compounds
Cadmium & Compounds	Cyanide Compounds	Polycyclic Organic Matter as 16-PAH

Cellophane Production

Carbon Disulfide	Toluene

Cellulose Food Casing Manufacturing

Carbon Disulfide

Chlorine Production

1,1,2,2-Tetrachloroethane	Carbonyl Sulfide	Hydrogen Fluoride (Hydrofluoric Acid)
1,1,2-Trichloroethane	Chlorine	Hydroquinone
1,1-Dimethylhydrazine	Chlorobenzene	Manganese & Compounds
1,2,4-Trichlorobenzene	Chloroform	Mercury & Compounds
1,2-Epoxybutane	Chloroprene	Methanol
1,3-Butadiene	Chromium & Compounds	Methyl Chloride
1,3-Dichloropropene	Cresols (includes o,m,p)	Methyl Chloroform (1,1,1-Trichloroethane)
1,4-Dichlorobenzene	Cumene	Methyl Ethyl Ketone (2-Butanone)
1,4-Dioxane (1,4-Diethyleneoxide)	Dichlorethyl Ether	Methyl Isobutyl Ketone (Hexone)
4,4'-Methylenedianiline	Diethanolamine	Methylene Chloride
4-4'-Methylenediphenyl Diisocyanate	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Phenol
Acetaldehyde	Ethyl Acrylate	Phosgene
Acrolein	Ethyl Chloride	Polycyclic Organic Matter as 16-PAH
Acrylic Acid	Ethylbenzene	Propionaldehyde
Acrylonitrile	Ethylene Dichloride	Propylene Dichloride
Allyl Chloride	Ethylene Glycol	Propylene Oxide
Aniline	Ethylene Oxide	Styrene
Asbestos	Formaldehyde	Tetrachloroethylene
Benzene	Glycol Ethers	Toluene
Benzotrichloride	Hexachlorobutadiene	Trichloroethylene
Benzyl Chloride	Hexachlorocyclopentadiene	Vinyl Acetate
Biphenyl	Hexachloroethane	Vinyl Chloride
Carbon Disulfide	Hydrazine	Vinylidene Chloride
Carbon Tetrachloride	Hydrochloric Acid (Hydrogen Chloride [gas only])	Xylenes (includes o, m, and p)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Chromic Acid Anodizing

Chromium & Compounds	Mercury & Compounds

Chromium Refractories Production

Chromium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Nickel & Compounds
Ethylene Glycol	Methanol	Phenol
Formaldehyde	Methyl Chloroform (1,1,1-Trichloroethane)	Toluene
Hydrochloric Acid (Hydrogen Chloride [gas only])	Methyl Ethyl Ketone (2-Butanone)	

Clay Products Manufacturing

1,4-Dichlorobenzene	Cobalt Compounds	Methyl Chloroform (1,1,1-Trichloroethane)
2,4-Toluene Diisocyanate	Dibutyl Phthalate	Methyl Ethyl Ketone (2-Butanone)
Acrylonitrile	Dimethyl Phthalate	Methyl Iodide (Iodomethane)
Antimony & Compounds	Ethylbenzene	Methylene Chloride
Arsenic & Compounds (inorganic including Arsine)	Ethylene Glycol	Nickel & Compounds
Benzene	Glycol Ethers	Phenol
Beryllium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Phosphorus
Bis(2-ethylhexyl)phthalate	Hydrogen Fluoride (Hydrofluoric Acid)	Polycyclic Organic Matter as 16-PAH
Cadmium & Compounds	Isophorone	Styrene
Carbon Disulfide	Lead & Compounds	Tetrachloroethylene
Carbon Tetrachloride	Manganese & Compounds	Toluene
Chlorine	Mercury & Compounds	Trichloroethylene
Chlorobenzene	Methanol	Vinyl Acetate
Chloroform	Methyl Bromide (Bromomethane)	Xylenes (includes o, m, and p)
Chromium & Compounds	Methyl Chloride	

Coke By-Product Plants

1,3-Butadiene	Cyanide Compounds	Phenol
2,4-Dinitrophenol	Ethylbenzene	Polycyclic Organic Matter as 16-PAH
Antimony & Compounds	Ethylene Glycol	Quinoline
Benzene	Glycol Ethers	Styrene
Biphenyl	Hydrochloric Acid (Hydrogen Chloride [gas only])	Tetrachloroethylene
Carbon Disulfide	Lead & Compounds	Toluene
Carbonyl Sulfide	Manganese & Compounds	Trichloroethylene
Chlorine	Methanol	Xylenes (includes o, m, and p)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Chromium & Compounds	Methyl Isobutyl Ketone (Hexone)	
Cresols (includes o,m,p)	Nickel & Compounds	

Coke Ovens: Charging, Top Side, and Door Leaks

Benzene	Coke Oven Emissions	Polycyclic Organic Matter as 16-PAH

Coke Ovens: Pushing, Quenching, and Battery Stacks

Benzene	Carbonyl Sulfide	Toluene
Carbon Disulfide	Polycyclic Organic Matter as 16-PAH	

Commercial Sterilization Facilities

Ethylene Oxide

Crematories

Arsenic & Compounds (inorganic including Arsine)	Chromium & Compounds	Mercury & Compounds
Beryllium & Compounds	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Nickel & Compounds
Cadmium & Compounds	Formaldehyde	Polycyclic Organic Matter as 16-PAH

Decorative Chromium Electroplating

Chromium & Compounds

Dry Cleaning Facilities

Tetrachloroethylene

Ferroalloys Production

Antimony & Compounds	Ethylene Glycol	Methyl Chloroform (1,1,1-Trichloroethane)
Chlorine	Hydrochloric Acid (Hydrogen Chloride [gas only])	Nickel & Compounds
Chromium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Polycyclic Organic Matter as 16-PAH
Cobalt Compounds	Lead & Compounds	
Cyanide Compounds	Manganese & Compounds	

Flat Wood Paneling (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Toluene
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Flexible Polyurethane Foam Fabrication Operations

Methylene Chloride		

Flexible Polyurethane Foam Production

2,4-Toluene Diisocyanate	4-4'-Methylenediphenyl Diisocyanate	Methylene Chloride

Friction Products Manufacturing

1,4-Dichlorobenzene	Glycol Ethers	Methyl Isobutyl Ketone (Hexone)
Bis(2-ethylhexyl)phthalate	Hydrochloric Acid (Hydrogen Chloride [gas only])	Methylene Chloride
Carbon Disulfide	Hydrogen Fluoride (Hydrofluoric Acid)	Nickel & Compounds
Chromium & Compounds	Lead & Compounds	Phenol
Dibutyl Phthalate	Manganese & Compounds	Polycyclic Organic Matter as 16-PAH
Ethylbenzene	Methanol	Tetrachloroethylene
Ethylene Glycol	Methyl Chloroform (1,1,1-Trichloroethane)	Toluene
Formaldehyde	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)

Gasoline Distribution (Stage 1)

2,2,4-Trimethylpentane	Ethylene Dichloride	Polycyclic Organic Matter as 16-PAH
Benzene	Hexane	Toluene
Cumene	Lead & Compounds	Xylenes (includes o, m, and p)
Ethylbenzene	Methyl tert-Butyl Ether	

Halogenated Solvent Cleaners

Methyl Chloroform (1,1,1-Trichloroethane)	Tetrachloroethylene	
Methylene Chloride	Trichloroethylene	

Hard Chromium Electroplating

Chromium & Compounds		

Hazardous Waste Incineration

1,1,2,2-Tetrachloroethane	Chloroform	Polychlorinated Biphenyls (Aroclors)
1,1,2-Trichloroethane	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Polycyclic Organic Matter as 16-PAH
Arsenic & Compounds (inorganic including Arsine)	Hydrochloric Acid (Hydrogen Chloride [gas only])	Vinyl Chloride

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Benzene	Mercury & Compounds
Carbon Tetrachloride	Methyl Chloroform (1,1,1-Trichloroethane)

Hydrogen Fluoride Production

Hydrogen Fluoride (Hydrofluoric Acid)

Industrial Boilers

1,4-Dichlorobenzene	Chloroform	Methyl Chloride
2,4-Dinitrophenol	Chromium & Compounds	Methyl Chloroform (1,1,1-Trichloroethane)
2,4-Dinitrotoluene	Cobalt Compounds	Methyl Ethyl Ketone (2-Butanone)
2-Chloroacetophenone	Cumene	Methyl Methacrylate
4-Nitrophenol	Cyanide Compounds	Methyl tert-Butyl Ether
Acetaldehyde	Dimethyl Sulfate	Methylene Chloride
Acetophenone	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylhydrazine
Acrolein	Ethyl Chloride	Nickel & Compounds
Antimony & Compounds	Ethylbenzene	Phenol
Arsenic & Compounds (inorganic including Arsine)	Ethylene Dibromide	Phosphorus
Benzene	Ethylene Dichloride	Polychlorinated Biphenyls (Aroclors)
Benzyl Chloride	Formaldehyde	Polycyclic Organic Matter as 16-PAH
Beryllium & Compounds	Hexane	Propionaldehyde
Bis(2-ethylhexyl)phthalate	Hydrochloric Acid (Hydrogen Chloride [gas only])	Selenium Compounds
Bromoform	Isophorone	Styrene
Cadmium & Compounds	Lead & Compounds	Tetrachloroethylene
Carbon Disulfide	Manganese & Compounds	Toluene
Chlorine	Mercury & Compounds	Vinyl Acetate
Chlorobenzene	Methyl Bromide (Bromomethane)	Xylenes (includes o, m, and p)

Industrial Process Cooling Towers

Chromium & Compounds

Institutional/Commercial Boilers

2,4-Dinitrophenol	Chloroform	Methyl Ethyl Ketone (2-Butanone)
2,4-Dinitrotoluene	Chromium & Compounds	Methyl Methacrylate
2-Chloroacetophenone	Cobalt Compounds	Methyl tert-Butyl Ether
4-Nitrophenol	Cumene	Methylene Chloride
Acetaldehyde	Cyanide Compounds	Methylhydrazine
Acetophenone	Dimethyl Sulfate	Nickel & Compounds
Acrolein	Ethyl Chloride	Phenol

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Antimony & Compounds	Ethylbenzene	Polycyclic Organic Matter as 16-PAH
Arsenic & Compounds (inorganic including Arsine)	Ethylene Dibromide	Propionaldehyde
Benzene	Ethylene Dichloride	Selenium Compounds
Benzyl Chloride	Formaldehyde	Styrene
Beryllium & Compounds	Hexane	Tetrachloroethylene
Bis(2-ethylhexyl)phthalate	Isophorone	Toluene
Bromoform	Lead & Compounds	Vinyl Acetate
Cadmium & Compounds	Manganese & Compounds	Xylenes (includes o, m, and p)
Carbon Disulfide	Mercury & Compounds	
Chlorine	Methyl Bromide (Bromomethane)	
Chlorobenzene	Methyl Chloroform (1,1,1-Trichloroethane)	

Integrated Iron and Steel Manufacturing

4-4'-Methylenediphenyl Diisocyanate	Hydrogen Fluoride (Hydrofluoric Acid)	Nickel & Compounds
Benzene	Lead & Compounds	Phenol
Chromium & Compounds	Manganese & Compounds	Polycyclic Organic Matter as 16-PAH
Cobalt Compounds	Methanol	Toluene
Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methyl Chloroform (1,1,1-Trichloroethane)	Trichloroethylene
Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)
Hydrochloric Acid (Hydrogen Chloride [gas only])	Methyl Isobutyl Ketone (Hexone)	

Iron Foundries

1,4-Dioxane (1,4-Diethyleneoxide)	Ethylbenzene	Methyl Isobutyl Ketone (Hexone)
4-4'-Methylenediphenyl Diisocyanate	Ethylene Glycol	Methyl Isocyanate
Antimony & Compounds	Formaldehyde	Methylene Chloride
Arsenic & Compounds (inorganic including Arsine)	Glycol Ethers	Nickel & Compounds
Benzene	Hydrochloric Acid (Hydrogen Chloride [gas only])	Phenol
Cadmium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Polycyclic Organic Matter as 16-PAH
Chlorine	Lead & Compounds	Styrene
Chromium & Compounds	Manganese & Compounds	Toluene
Cobalt Compounds	Methanol	Trichloroethylene
Cumene	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)
Diethanolamine	Methyl Ethyl Ketone (2-Butanone)	

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Large Appliance (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)
Glycol Ethers	Toluene	

Leather Tanning and Finishing Operations

Chlorine	Hydrochloric Acid (Hydrogen Chloride [gas only])	Tetrachloroethylene
Chromium & Compounds	Methanol	Toluene
Formaldehyde	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	

Lime Manufacturing

Chromium & Compounds	Lead & Compounds	Phenol
Hydrochloric Acid (Hydrogen Chloride [gas only])	Mercury & Compounds	

Magnetic Tape (Surface Coating)

Methyl Ethyl Ketone (2-Butanone)	Methyl Isobutyl Ketone (Hexone)	Toluene

Marine Vessel Loading Operations

Benzene	Toluene
Hexane	Xylenes (includes o, m, and p)

Medical Waste Incinerators

1,1,2,2-Tetrachloroethane	Chromium & Compounds	Methyl Chloroform (1,1,1-Trichloroethane)
Antimony & Compounds	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylene Chloride
Arsenic & Compounds (inorganic including Arsine)	Ethylene Dichloride	Nickel & Compounds
Benzene	Formaldehyde	Polychlorinated Biphenyls (Aroclors)
Beryllium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Polycyclic Organic Matter as 16-PAH
Cadmium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Tetrachloroethylene
Carbon Tetrachloride	Lead & Compounds	Toluene
Chlorine	Manganese & Compounds	Trichloroethylene
Chloroform	Mercury & Compounds	Xylenes (includes o, m, and p)

Metal Can (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Toluene
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Metal Coil (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Toluene
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)

Metal Furniture (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Toluene
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)

Mineral Wool Production

4-4'-Methylenediphenyl Diisocyanate	Formaldehyde	Styrene
Chromium & Compounds	Methanol	Toluene
Ethylbenzene	Methyl Chloroform (1,1,1-Trichloroethane)	Vinyl Acetate
Ethylene Glycol	Phenol	Xylenes (includes o, m, and p)

Miscellaneous Metal Parts and Products (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Toluene
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)

MON

1,1,2,2-Tetrachloroethane	Catechol	Methanol
1,1,2-Trichloroethane	Chlordane	Methyl Bromide (Bromomethane)
1,1-Dimethylhydrazine	Chlorine	Methyl Chloride
1,2,4-Trichlorobenzene	Chloroacetic Acid	Methyl Chloroform (1,1,1-Trichloroethane)
1,2-Propylenimine (2-Methylaziridine)	Chlorobenzene	Methyl Ethyl Ketone (2-Butanone)
1,3-Butadiene	Chloroform	Methyl Iodide (Iodomethane)
1,3-Dichloropropene	Chloromethyl Methyl Ether	Methyl Isobutyl Ketone (Hexone)
1,4-Dichlorobenzene	Chloroprene	Methyl Isocyanate
1,4-Dioxane (1,4-Diethyleneoxide)	Chromium & Compounds	Methyl Methacrylate
2,4-D (2,4-Dichlorophenoxyacetic Acid)	Cobalt Compounds	Methyl tert-Butyl Ether
2,4-Dinitrophenol	Cresols (includes o,m,p)	Methylene Chloride
2,4-Dinitrotoluene	Cumene	Methylhydrazine
2,4-Toluene Diisocyanate	Cyanide Compounds	N,N-Dimethylaniline
2-Nitropropane	Dibutyl Phthalate	Nickel & Compounds
3,3'-Dichlorobenzidene	Dichlorethyl Ether	Nitrobenzene
4,4'-Methylenedianiline	Dichlorvos	o-Anisidine
4,6-Dinitro-o-cresol (including salts)	Diethanolamine	p-Phenylenediamine
4-4'-Methylenediphenyl Diisocyanate	Diethyl Sulfate	Pentachloronitrobenzene (Quintobenzene)
4-Nitrophenol	Dimethyl Phthalate	Phenol

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Acetaldehyde	Dimethyl Sulfate	Phosgene
Acetamide	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Phosphorus
Acetonitrile	Ethyl Acrylate	Phthalic Anhydride
Acrolein	Ethyl Chloride	Polycyclic Organic Matter as 16-PAH
Acrylamide	Ethylbenzene	Propionaldehyde
Acrylic Acid	Ethylene Dibromide	Propylene Dichloride
Acrylonitrile	Ethylene Dichloride	Propylene Oxide
Allyl Chloride	Ethylene Glycol	Quinoline
Aniline	Ethylene Oxide	Quinone (p-Benzoquinone)
Antimony & Compounds	Formaldehyde	Selenium Compounds
Arsenic & Compounds (inorganic including Arsine)	Glycol Ethers	Styrene
Benzene	Heptachlor	Styrene Oxide
Benzotrichloride	Hexachlorobenzene	Tetrachloroethylene
Benzyl Chloride	Hexachlorobutadiene	Titanium Tetrachloride
Beryllium & Compounds	Hexachlorocyclopentadiene	Toluene
Biphenyl	Hexachloroethane	Trichloroethylene
Bis(chloromethyl) Ether	Hydrazine	Trifluralin
Cadmium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Vinyl Acetate
Calcium Cyanamide	Hydrogen Fluoride (Hydrofluoric Acid)	Vinyl Bromide
Captan	Hydroquinone	Vinyl Chloride
Carbaryl	Lead & Compounds	Vinylidene Chloride
Carbon Disulfide	Maleic Anhydride	Xylenes (includes o, m, and p)
Carbon Tetrachloride	Manganese & Compounds	
Carbonyl Sulfide	Mercury & Compounds	

Municipal Landfills

1,1,2,2-Tetrachloroethane	Ethylbenzene	Polycyclic Organic Matter as 16-PAH
Acrylonitrile	Ethylene Dichloride	Propylene Dichloride
Benzene	Ethylidene Dichloride	Tetrachloroethylene
Carbon Disulfide	Hexane	Toluene
Carbon Tetrachloride	Methyl Chloroform (1,1,1-Trichloroethane)	Trichloroethylene
Carbonyl Sulfide	Methyl Ethyl Ketone (2-Butanone)	Vinyl Chloride
Chlorobenzene	Methyl Isobutyl Ketone (Hexone)	Vinylidene Chloride
Chloroform	Methylene Chloride	Xylenes (includes o, m, and p)
Ethyl Chloride	Polychlorinated Biphenyls (Aroclors)	

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Municipal Waste Combustors

Acetaldehyde	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Mercury & Compounds
Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Nickel & Compounds
Beryllium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Polychlorinated Biphenyls (Aroclors)
Cadmium & Compounds	Lead & Compounds	Polycyclic Organic Matter as 16-PAH
Chromium & Compounds	Manganese & Compounds	

Oil and Natural Gas Production

2,2,4-Trimethylpentane	Ethylbenzene	Toluene
Benzene	Hexane	Xylenes (includes o, m, and p)

Other Biological Incineration

Acetaldehyde	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Polychlorinated Biphenyls (Aroclors)
Cadmium & Compounds	Ethylene Dichloride	

Paper and Other Webs (Surface Coating)

1,1,2-Trichloroethane	Cumene	Methyl Ethyl Ketone (2-Butanone)
1,4-Dioxane (1,4-Diethyleneoxide)	Cyanide Compounds	Methyl Isobutyl Ketone (Hexone)
2,4-Toluene Diisocyanate	Dibutyl Phthalate	Methyl Methacrylate
Acetaldehyde	Diethanolamine	Methylene Chloride
Acetonitrile	Diethyl Sulfate	N,N-Dimethylaniline
Acrylamide	Dimethyl Sulfate	Nickel & Compounds
Acrylic Acid	Ethyl Acrylate	Phenol
Acrylonitrile	Ethylbenzene	Phthalic Anhydride
Aniline	Ethylene Dichloride	Polycyclic Organic Matter as 16-PAH
Antimony & Compounds	Ethylene Glycol	Propylene Dichloride
Asbestos	Ethylene Oxide	Propylene Oxide
Benzene	Formaldehyde	Selenium Compounds
Biphenyl	Glycol Ethers	Styrene
Bis(2-ethylhexyl)phthalate	Hydrochloric Acid (Hydrogen Chloride [gas only])	Tetrachloroethylene
Cadmium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Toluene
Catechol	Hydroquinone	Trichloroethylene
Chlorine	Lead & Compounds	Vinyl Acetate
Chlorobenzene	Maleic Anhydride	Vinyl Chloride
Chloroform	Manganese & Compounds	Vinylidene Chloride
Chromium & Compounds	Methanol	Xylenes (includes o, m, and p)
Cobalt Compounds	Methyl Bromide (Bromomethane)	
Cresols (includes o,m,p)	Methyl Chloroform (1,1,1-Trichloroethane)	

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Petroleum Refineries Catalytic Cracking (Fluid and other) Units, Catalytic Reforming Units, and Sulfur Plant Units

Polycyclic Organic Matter as 16-PAH

Petroleum Refineries: Other Sources Not Distinctly Listed

2,2,4-Trimethylpentane	Ethylbenzene	Styrene
Benzene	Hexane	Toluene
Biphenyl	Methyl tert-Butyl Ether	Xylenes (includes o, m, and p)
Cresols (includes o,m,p)	Phenol	
Cumene	Polycyclic Organic Matter as 16-PAH	

Pharmaceuticals Production

1,1,2-Trichloroethane	Dichlorvos	Methyl Ethyl Ketone (2-Butanone)
1,2-Epoxybutane	Diethanolamine	Methyl Iodide (Iodomethane)
1,2-Propylenimine (2-Methylaziridine)	Diethyl Sulfate	Methyl Isobutyl Ketone (Hexone)
1,4-Dioxane (1,4-Diethyleneoxide)	Dimethyl Phthalate	Methyl tert-Butyl Ether
Acetonitrile	Dimethyl Sulfate	Methylene Chloride
Acetophenone	Dimethylformamide	N,N-Dimethylaniline
Acrylic Acid	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	N-Nitrosodimethylamine
Acrylonitrile	Ethyl Acrylate	Nickel & Compounds
Allyl Chloride	Ethyl Chloride	Nitrobenzene
Aniline	Ethylbenzene	Phenol
Arsenic & Compounds (inorganic including Arsine)	Ethylene Dibromide	Phosgene
Benzene	Ethylene Dichloride	Phthalic Anhydride
Benzyl Chloride	Ethylene Glycol	Polycyclic Organic Matter as 16-PAH
Biphenyl	Ethylene Oxide	Propylene Oxide
Bis(2-ethylhexyl)phthalate	Formaldehyde	Quinoline
Carbon Disulfide	Glycol Ethers	Selenium Compounds
Carbon Tetrachloride	Hexane	Tetrachloroethylene
Chlorine	Hydrazine	Toluene
Chloroacetic Acid	Hydrochloric Acid (Hydrogen Chloride [gas only])	Trichloroethylene
Chlorobenzene	Maleic Anhydride	Triethylamine
Chloroform	Manganese & Compounds	Trifluralin
Chloromethyl Methyl Ether	Methanol	Vinyl Acetate
Cumene	Methyl Chloride	Vinylidene Chloride
Cyanide Compounds	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Phosphate Fertilizers Production

Chlorine	Manganese & Compounds	Phosphorus
Hydrochloric Acid (Hydrogen Chloride [gas only])	Methanol	Toluene
Hydrogen Fluoride (Hydrofluoric Acid)	Methyl Chloroform (1,1,1-Trichloroethane)	
Lead & Compounds	Methyl Isobutyl Ketone (Hexone)	

Phosphoric Acid Manufacturing

Hydrogen Fluoride (Hydrofluoric Acid)

Plywood/Particle Board Manufacturing

4-4'-Methylenediphenyl Diisocyanate	Formaldehyde	Methylene Chloride
Acetaldehyde	Glycol Ethers	Pentachlorophenol
Arsenic & Compounds (inorganic including Arsine)	Hydrochloric Acid (Hydrogen Chloride [gas only])	Phenol
Bis(2-ethylhexyl)phthalate	Methanol	Styrene
Chlorine	Methyl Chloroform (1,1,1-Trichloroethane)	Tetrachloroethylene
Chromium & Compounds	Methyl Ethyl Ketone (2-Butanone)	Toluene
Dibutyl Phthalate	Methyl Isobutyl Ketone (Hexone)	Trichloroethylene
Ethylbenzene	Methyl Isocyanate	Xylenes (includes o, m, and p)
Ethylene Glycol	Methyl Methacrylate	

Polycarbonates Production

Ethyl Chloride	Methylene Chloride

Polyether Polyols Production

Ethylene Oxide	Propylene Oxide
Hexane	Toluene

Polymers & Resins (Excluding P&R III)

1,1,2,2-Tetrachloroethane	Chlorine	Methanol
1,1-Dimethylhydrazine	Chloroacetic Acid	Methyl Bromide (Bromomethane)
1,2-Epoxybutane	Chlorobenzene	Methyl Chloride
1,2-Propylenimine (2-Methylaziridine)	Chloroform	Methyl Chloroform (1,1,1-Trichloroethane)
1,3-Butadiene	Chloromethyl Methyl Ether	Methyl Ethyl Ketone (2-Butanone)
1,3-Dichloropropene	Chloroprene	Methyl Isobutyl Ketone (Hexone)
1,4-Dioxane (1,4-Diethyleneoxide)	Chromium & Compounds	Methyl Methacrylate
2,4,6-Trichlorophenol	Cobalt Compounds	Methyl tert-Butyl Ether
2,4-D (2,4-Dichlorophenoxyacetic Acid)	Cresols (includes o,m,p)	Methylene Chloride

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

2,4-Dinitrophenol	Cumene	N,N-Dimethylaniline
2,4-Toluene Diisocyanate	Dibutyl Phthalate	Nickel & Compounds
4,4'-Methylenebis(2-chloroaniline)	Diethanolamine	Nitrobenzene
4,4'-Methylenedianiline	Diethyl Sulfate	o-Toluidine
4-4'-Methylenediphenyl Diisocyanate	Dimethyl Phthalate	p-Phenylenediamine
Acetaldehyde	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Phenol
Acetonitrile	Ethyl Acrylate	Phosgene
Acrolein	Ethyl Chloride	Phthalic Anhydride
Acrylamide	Ethylbenzene	Polycyclic Organic Matter as 16-PAH
Acrylic Acid	Ethylene Dibromide	Propionaldehyde
Acrylonitrile	Ethylene Dichloride	Propoxur (Baygon)
Allyl Chloride	Ethylene Glycol	Propylene Dichloride
Aniline	Ethylene Oxide	Propylene Oxide
Antimony & Compounds	Formaldehyde	Styrene
Benzene	Glycol Ethers	Tetrachloroethylene
Benzyl Chloride	Hydrazine	Titanium Tetrachloride
Biphenyl	Hydrochloric Acid (Hydrogen Chloride [gas only])	Toluene
Bis(2-ethylhexyl)phthalate	Hydrogen Fluoride (Hydrofluoric Acid)	Trichloroethylene
Bis(chloromethyl) Ether	Hydroquinone	Vinyl Acetate
Cadmium & Compounds	Lead & Compounds	Vinyl Bromide
Carbon Disulfide	Maleic Anhydride	Vinyl Chloride
Carbon Tetrachloride	Manganese & Compounds	Vinylidene Chloride
Carbonyl Sulfide	Mercury & Compounds	Xylenes (includes o, m, and p)

Polymers and Resins III

Formaldehyde	Phenol
Methanol	Xylenes (includes o, m, and p)

Portland Cement Manufacturing: Hazardous Waste-fired

1,1,2,2-Tetrachloroethane	Dibutyl Phthalate	Methyl Isobutyl Ketone (Hexone)
1,1,2-Trichloroethane	Diethanolamine	Methyl Methacrylate
1,2,4-Trichlorobenzene	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylene Chloride
1,4-Dichlorobenzene	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Nickel & Compounds
2-Nitropropane	Ethylbenzene	Nitrobenzene
Acetonitrile	Ethylene Dichloride	Pentachlorophenol
Acrylonitrile	Ethylene Glycol	Phenol
Aniline	Formaldehyde	Phthalic Anhydride
Benzene	Glycol Ethers	Polycyclic Organic Matter as 16-PAH
Carbon Disulfide	Hydrochloric Acid (Hydrogen Chloride [gas only])	Propylene Oxide
Chlorine	Lead & Compounds	Styrene

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Chlorobenzene	Maleic Anhydride	Tetrachloroethylene
Chloroform	Mercury & Compounds	Toluene
Chromium & Compounds	Methanol	Trichloroethylene
Cresols (includes o,m,p)	Methyl Chloroform (1,1,1-Trichloroethane)	Vinyl Acetate
Cumene	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)

Portland Cement Manufacturing: Non-Hazardous Waste-fired

1,1,2,2-Tetrachloroethane	Dibutyl Phthalate	Methyl Isobutyl Ketone (Hexone)
1,1,2-Trichloroethane	Diethanolamine	Methyl Methacrylate
1,2,4-Trichlorobenzene	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylene Chloride
1,4-Dichlorobenzene	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Nickel & Compounds
2-Nitropropane	Ethylbenzene	Nitrobenzene
Acetonitrile	Ethylene Dichloride	Pentachlorophenol
Acrylonitrile	Ethylene Glycol	Phenol
Aniline	Formaldehyde	Phthalic Anhydride
Benzene	Glycol Ethers	Polycyclic Organic Matter as 16-PAH
Carbon Disulfide	Hydrochloric Acid (Hydrogen Chloride [gas only])	Propylene Oxide
Chlorine	Lead & Compounds	Styrene
Chlorobenzene	Maleic Anhydride	Tetrachloroethylene
Chloroform	Mercury & Compounds	Toluene
Chromium & Compounds	Methanol	Trichloroethylene
Cresols (includes o,m,p)	Methyl Chloroform (1,1,1-Trichloroethane)	Vinyl Acetate
Cumene	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)

Primary Aluminum Production

Carbonyl Sulfide	Glycol Ethers	Methyl Ethyl Ketone (2-Butanone)
Chlorine	Hydrochloric Acid (Hydrogen Chloride [gas only])	Methyl Isobutyl Ketone (Hexone)
Chromium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Nickel & Compounds
Cumene	Lead & Compounds	Polycyclic Organic Matter as 16-PAH

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Cyanide Compounds	Manganese & Compounds	Toluene
Ethylene Glycol	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)

Primary Copper Smelting

Antimony & Compounds	Cobalt Compounds	Methyl Chloroform (1,1,1-Trichloroethane)
Arsenic & Compounds (inorganic including Arsine)	Cresols (includes o,m,p)	Nickel & Compounds
Beryllium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Selenium Compounds
Cadmium & Compounds	Lead & Compounds	Styrene
Chlorine	Manganese & Compounds	
Chromium & Compounds	Mercury & Compounds	

Primary Lead Smelting

Antimony & Compounds	Lead & Compounds	Nickel & Compounds
Arsenic & Compounds (inorganic including Arsine)	Manganese & Compounds	
Cadmium & Compounds	Mercury & Compounds	

Primary Magnesium Refining

Chlorine	Hydrochloric Acid (Hydrogen Chloride [gas only])

Printing/Publishing (Surface Coating)

1,4-Dioxane (1,4-Diethyleneoxide)	Cumene	Methyl Ethyl Ketone (2-Butanone)
2-Nitropropane	Cyanide Compounds	Methyl Isobutyl Ketone (Hexone)
4-4'-Methylenediphenyl Diisocyanate	Dibutyl Phthalate	Methylene Chloride
Acrylic Acid	Ethylbenzene	Nickel & Compounds
Antimony & Compounds	Ethylene Glycol	Phenol
Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Phthalic Anhydride
Benzene	Glycol Ethers	Polycyclic Organic Matter as 16-PAH
Bis(2-ethylhexyl)phthalate	Hydrochloric Acid (Hydrogen Chloride [gas only])	Tetrachloroethylene
Cadmium & Compounds	Lead & Compounds	Toluene
Chlorine	Maleic Anhydride	Trichloroethylene
Chromium & Compounds	Methanol	Vinyl Acetate
Cobalt Compounds	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)

Publicly Owned Treatment Works (POTW) Emissions

Acrylonitrile	Methanol	Tetrachloroethylene
Benzene	Methyl Chloroform (1,1,1-Trichloroethane)	Toluene
Carbon Disulfide	Methyl Ethyl Ketone (2-Butanone)	Trichloroethylene

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Chloroform	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)
Ethylbenzene	Methylene Chloride	
Glycol Ethers	Styrene	

Pulp and Paper Production (combustion) MACT II

Acetaldehyde	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methyl Isobutyl Ketone (Hexone)
Antimony & Compounds	Formaldehyde	Nickel & Compounds
Arsenic & Compounds (inorganic including Arsine)	Hydrochloric Acid (Hydrogen Chloride [gas only])	Phenol
Benzene	Lead & Compounds	Polycyclic Organic Matter as 16-PAH
Beryllium & Compounds	Manganese & Compounds	Selenium Compounds
Cadmium & Compounds	Mercury & Compounds	Styrene
Chromium & Compounds	Methanol	Toluene
Cobalt Compounds	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)

Pulp and Paper Production (non-combustion) MACT I

1,1,2-Trichloroethane	Chloroform	Methyl Ethyl Ketone (2-Butanone)
1,2,4-Trichlorobenzene	Cresols (includes o,m,p)	Methyl Isobutyl Ketone (Hexone)
Acetaldehyde	Cumene	Methylene Chloride
Acetophenone	Ethylbenzene	Phenol
Acrolein	Ethylene Dichloride	Propionaldehyde
Benzene	Formaldehyde	Styrene
Benzotrichloride	Hexane	Tetrachloroethylene
Carbon Disulfide	Hydrochloric Acid (Hydrogen Chloride [gas only])	Toluene
Carbon Tetrachloride	Methanol	Trichloroethylene
Chlorine	Methyl Chloride	Xylenes (includes o, m, and p)
Chlorobenzene	Methyl Chloroform (1,1,1-Trichloroethane)	

Rayon Production

Biphenyl	Chlorine	Glycol Ethers
Carbon Disulfide	Ethylene Glycol	Methanol

Scrap or Waste Tire Incineration

Dioxin/Furans as 2,3,7,8-TCDD TEQ	Polychlorinated Biphenyls (Aroclors)	Polycyclic Organic Matter as 16-PAH

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Secondary Aluminum Production

Antimony & Compounds	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Lead & Compounds
Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Manganese & Compounds
Cadmium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Mercury & Compounds
Chromium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Nickel & Compounds

Secondary Lead Smelting

1,1,2,2-Tetrachloroethane	Chlorobenzene	Methyl Chloride
1,3-Butadiene	Chloroform	Methyl Ethyl Ketone (2-Butanone)
1,3-Dichloropropene	Chromium & Compounds	Methyl Iodide (Iodomethane)
Acetaldehyde	Cumene	Methylene Chloride
Acetophenone	Dibutyl Phthalate	Nickel & Compounds
Acrolein	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Phenol
Acrylonitrile	Ethyl Carbamate (Urethane)	Polycyclic Organic Matter as 16-PAH
Antimony & Compounds	Ethylbenzene	Propionaldehyde
Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Styrene
Benzene	Hexane	Toluene
Biphenyl	Lead & Compounds	Trichloroethylene
Bis(2-ethylhexyl)phthalate	Manganese & Compounds	Xylenes (includes o, m, and p)
Cadmium & Compounds	Mercury & Compounds	
Carbon Disulfide	Methyl Bromide (Bromomethane)	

Semiconductor Manufacturing

1,2,4-Trichlorobenzene	Hydrogen Fluoride (Hydrofluoric Acid)	Methylene Chloride
Antimony & Compounds	Hydroquinone	Phenol
Catechol	Lead & Compounds	Tetrachloroethylene
Chlorine	Manganese & Compounds	Toluene
Ethylbenzene	Methanol	Trichloroethylene
Ethylene Glycol	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)
Glycol Ethers	Methyl Ethyl Ketone (2-Butanone)	
Hydrochloric Acid (Hydrogen Chloride [gas only])	Methyl Isobutyl Ketone (Hexone)	

Sewage Sludge Incineration

1,1,2,2-Tetrachloroethane	Chloroform	Methylene Chloride
1,4-Dichlorobenzene	Chromium & Compounds	Nickel & Compounds
Acetaldehyde	Cobalt Compounds	Phenol
Acetonitrile	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Phosphorus
Acrylonitrile	Ethylbenzene	Polychlorinated Biphenyls (Aroclors)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Antimony & Compounds	Ethylene Dichloride	Polycyclic Organic Matter as 16-PAH
Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Selenium Compounds
Benzene	Hydrochloric Acid (Hydrogen Chloride [gas only])	Tetrachloroethylene
Beryllium & Compounds	Lead & Compounds	Toluene
Bis(2-ethylhexyl)phthalate	Manganese & Compounds	Trichloroethylene
Cadmium & Compounds	Mercury & Compounds	Vinyl Chloride
Carbon Tetrachloride	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)
Chlorobenzene	Methyl Ethyl Ketone (2-Butanone)	

Shipbuilding and Ship Repair (Surface Coating)

Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)
Methyl Ethyl Ketone (2-Butanone)	Toluene	

Spandex Production

2,4-Toluene Diisocyanate	Methylene Chloride	Toluene

Stationary Internal Combustion Engines

1,3-Butadiene	Benzene	Polycyclic Organic Matter as 16-PAH
Acetaldehyde	Formaldehyde	Toluene
Acrolein	Mercury & Compounds	Xylenes (includes o, m, and p)

Stationary Turbines

Acetaldehyde	Formaldehyde	Phenol
Benzene	Manganese & Compounds	Polycyclic Organic Matter as 16-PAH
Cadmium & Compounds	Mercury & Compounds	Toluene
Chromium & Compounds	Nickel & Compounds	Xylenes (includes o, m, and p)

Steel Foundries

1,1,2-Trichloroethane	Cresols (includes o,m,p)	Methyl Ethyl Ketone (2-Butanone)
2,4-Dinitrophenol	Cumene	Methyl Isobutyl Ketone (Hexone)
4-4'-Methylenediphenyl Diisocyanate	Cyanide Compounds	Methylene Chloride
Antimony & Compounds	Diethanolamine	Nickel & Compounds
Arsenic & Compounds (inorganic including Arsine)	Ethylbenzene	Phenol
Benzene	Ethylene Glycol	Phosphorus
Beryllium & Compounds	Formaldehyde	Polycyclic Organic Matter as 16-PAH
Biphenyl	Glycol Ethers	Quinoline
Cadmium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Selenium Compounds
Carbon Disulfide	Hydrogen Fluoride (Hydrofluoric Acid)	Styrene

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Carbonyl Sulfide	Lead & Compounds	Tetrachloroethylene
Chlorine	Manganese & Compounds	Toluene
Chlorobenzene	Mercury & Compounds	Trichloroethylene
Chromium & Compounds	Methanol	Xylenes (includes o, m, and p)
Cobalt Compounds	Methyl Chloroform (1,1,1-Trichloroethane)	

Steel Pickling HCl Process

Chlorine	Hydrochloric Acid (Hydrogen Chloride [gas only])

Taconite Iron Ore Processing

Benzene	Lead & Compounds
Formaldehyde	Toluene

Tire Production

1,1,2,2-Tetrachloroethane	Benzotrichloride	Methyl Bromide (Bromomethane)
1,1,2-Trichloroethane	Benzyl Chloride	Methyl Chloride
1,2,4-Trichlorobenzene	Biphenyl	Methyl Chloroform (1,1,1-Trichloroethane)
1,2-Dibromo-3-chloropropane	Bis(2-ethylhexyl)phthalate	Methyl Ethyl Ketone (2-Butanone)
1,3-Butadiene	Bromoform	Methyl Isobutyl Ketone (Hexone)
1,4-Dichlorobenzene	Cadmium & Compounds	Methyl tert-Butyl Ether
1,4-Dioxane (1,4-Diethyleneoxide)	Carbon Disulfide	Methylene Chloride
2,2,4-Trimethylpentane	Carbon Tetrachloride	N,N-Dimethylaniline
2,4,5-Trichlorophenol	Carbonyl Sulfide	N-Nitrosodimethylamine
2,4,6-Trichlorophenol	Chlorobenzene	N-Nitrosomorpholine
2,4-Dinitrophenol	Chloroform	Nickel & Compounds
2,4-Dinitrotoluene	Chloroprene	Nitrobenzene
2-Chloroacetophenone	Chromium & Compounds	o-Anisidine
3,3'-Dichlorobenzidene	Cresols (includes o,m,p)	o-Toluidine
3,3'-Dimethoxybenzidine	Cumene	p-Phenylenediamine
3,3'-Dimethylbenzidine	Dibutyl Phthalate	Pentachloronitrobenzene (Quintobenzene)
4,4'-Methylenebis(2-chloroaniline)	Dichlorethyl Ether	Pentachlorophenol
4,4'-Methylenedianiline	Dimethyl Phthalate	Phenol
4,6-Dinitro-o-cresol (including salts)	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Polycyclic Organic Matter as 16-PAH
4-Aminobiphenyl	Ethyl Chloride	Propylene Dichloride
4-Dimethylaminoazobenzene	Ethylbenzene	Propylene Oxide
4-Nitrobiphenyl	Ethylene Dibromide	Styrene
4-Nitrophenol	Ethylene Dichloride	Tetrachloroethylene
Acetaldehyde	Ethylidene Dichloride	Toluene

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Acetonitrile	Hexachlorobenzene	Trichloroethylene
Acetophenone	Hexachlorobutadiene	Trifluralin
Acrolein	Hexachlorocyclopentadiene	Vinyl Acetate
Acrylonitrile	Hexachloroethane	Vinyl Chloride
Allyl Chloride	Hexane	Vinylidene Chloride
Aniline	Hydroquinone	Xylenes (includes o, m, and p)
Benzene	Isophorone	
Benzidine	Lead & Compounds	

Utilities - Coal

1,1,2-Trichloroethane	Cresols (includes o,m,p)	Methyl Isobutyl Ketone (Hexone)
1,3-Dichloropropene	Cumene	Methyl Methacrylate
2,4-Dinitrotoluene	Dibutyl Phthalate	Methyl tert-Butyl Ether
2-Chloroacetophenone	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylene Chloride
Acetaldehyde	Ethyl Chloride	N-Nitrosodimethylamine
Acetophenone	Ethylbenzene	Nickel & Compounds
Acrolein	Ethylene Dichloride	Pentachlorophenol
Antimony & Compounds	Formaldehyde	Phenol
Arsenic & Compounds (inorganic including Arsine)	Hexachlorobenzene	Phosphorus
Benzene	Hexane	Phthalic Anhydride
Benzyl Chloride	Hydrochloric Acid (Hydrogen Chloride [gas only])	Polycyclic Organic Matter as 16-PAH
Beryllium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Propionaldehyde
Bis(2-ethylhexyl)phthalate	Isophorone	Quinoline
Bromoform	Lead & Compounds	Selenium Compounds
Cadmium & Compounds	Manganese & Compounds	Styrene
Carbon Disulfide	Mercury & Compounds	Tetrachloroethylene
Carbon Tetrachloride	Methyl Bromide (Bromomethane)	Toluene
Chlorobenzene	Methyl Chloride	Trichloroethylene
Chloroform	Methyl Chloroform (1,1,1-Trichloroethane)	Vinyl Acetate
Chromium & Compounds	Methyl Ethyl Ketone (2-Butanone)	Vinylidene Chloride
Cobalt Compounds	Methyl Iodide (Iodomethane)	

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Utilities - Natural Gas

Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Phosphorus
Benzene	Lead & Compounds	Polycyclic Organic Matter as 16-PAH
Cadmium & Compounds	Manganese & Compounds	Toluene
Chromium & Compounds	Mercury & Compounds	
Cobalt Compounds	Nickel & Compounds	

Utilities - Oil

Acetaldehyde	Formaldehyde	Phenol
Arsenic & Compounds (inorganic including Arsine)	Hydrochloric Acid (Hydrogen Chloride [gas only])	Phosphorus
Benzene	Hydrogen Fluoride (Hydrofluoric Acid)	Polychlorinated Biphenyls (Aroclors)
Beryllium & Compounds	Lead & Compounds	Polycyclic Organic Matter as 16-PAH
Cadmium & Compounds	Manganese & Compounds	Selenium Compounds
Chromium & Compounds	Mercury & Compounds	Tetrachloroethylene
Cobalt Compounds	Methyl Chloroform (1,1,1-Trichloroethane)	Toluene
Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylene Chloride	Vinyl Acetate
Ethylbenzene	Nickel & Compounds	Xylenes (includes o, m, and p)

Utility Boilers - Coke

Beryllium & Compounds	Chromium & Compounds
Cadmium & Compounds	Nickel & Compounds

Utility Turbines

Antimony & Compounds	Chromium & Compounds	Mercury & Compounds
Arsenic & Compounds (inorganic including Arsine)	Cobalt Compounds	Nickel & Compounds
Benzene	Formaldehyde	Phosphorus
Beryllium & Compounds	Lead & Compounds	Selenium Compounds
Cadmium & Compounds	Manganese & Compounds	

Vegetable Oil Production

2,4-Toluene Diisocyanate	Maleic Anhydride	Toluene
4-4'-Methylenediphenyl Diisocyanate	Methanol	Xylenes (includes o, m, and p)
Biphenyl	Methyl Ethyl Ketone (2-Butanone)	
Hydrochloric Acid (Hydrogen Chloride [gas only])	Nickel & Compounds	

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Wood Furniture (Surface Coating)		
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)
Methyl Ethyl Ketone (2-Butanone)	Toluene	
Wool Fiberglass Manufacturing		
Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Methanol
Chromium & Compounds	Lead & Compounds	Phenol

APPENDIX K

EPA LIST OF PRIORITY HAPS AND

DATA REPORTING ELEMENTS

APPENDIX K

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List of HAPs Identified by EPA as Priority HAPs

HAP	CAS #
Acetaldehyde	75070
Acrolein	107028
Acrylamide	79061
Acrylonitrile	107131
Arsenic & compounds	
Benzene	71432
Benzyl chloride	100447
Beryllium & compounds	
bis(2-ethylhexyl)phthalate	117817
1,3-Butadiene	106990
Cadmium & compounds	
Carbon tetrachloride	56235
Chlorine	7782505
Chloroform	67663
Chromium & compounds	
Coke oven emissions	
1,2-Dibromoethane	106934
1,4-Dichlorobenzene(P)	106467
1,2-Dichloropropane	78875
1,3-Dichloropropene	542756
1,4-Dioxane	123911
Ethyl acrylate	140885
Ethylene dichloride	107062
Ethylene oxide	75218
Ethylidene dichloride	75343
Formaldehyde	50000
Glycol ethers	
Hexachlorobenzene	118741
Hexachlorocyclopentadiene	77474
Hydrazine	302012
Hydrochloric acid	7647010
Lead & compounds	
Maleic anhydride	108316
Manganese & compounds	
Mercury & compounds	
Methyl bromide	74839
Methyl chloride	74873

List of HAPs Identified by EPA as Priority HAPs (Continued)

HAP	CAS #
Methylene chloride	75092
MDI (methylene diphenyl diisocyanate)	101688
Nickel & compounds	
2-Nitropropane	79469
Phosgene	75445
POM (PAHs)**	
Quinoline	91225
2,3,7,8-TCDF/2,3,7,8-TCDD*	
Tetrachloroethylene	127184
Toluene	108883
Trichloroethylene	79016
Vinyl chloride	75014

* Inventory as TEQ.

** Inventory as sum of 16 PAH and speciate. 16 PAH compounds include:

Acenaphthene	Benzo(a)pyrene***	Chrysene***	Indeno(1,2,3-cd)pyrene***
Acenaphthylene	Benzo(b)fluoranthene***	Dibenz(a,h)anthracene***	Naphthalene
Anthracene	Benzo(ghi)perylene	Fluoranthene	Phenanthrene
Benz(a)anthracene***	Benzo(k)fluoranthene***	Fluorene	Pyrene

*** These 7 PAHs are carcinogenic and are usually reported as the sum of 7 PAH.

HAP Inventory Data Reporting Elements

Data Element	Major Sources	Area Sources
Start date (Inventory year)	✔	✔
State FIPS code	✔	✔
County FIPS code	✔	✔
Federal ID code (plant)	✔	
Federal ID code (point)	✔	
Federal ID code (process)	✔	
Site name	✔	
Physical address	✔	
SCC	✔	✔
Heat content (fuel)(annual)	✔	
Pollutant code	✔	✔
Activity/throughput (annual)	✔	✔
Work weekday emissions	✔	
Summer/winter work weekday emissions		✔
Annual emissions	✔	✔
Emission factor	✔	✔
Winter throughput (%)	✔	✔
Spring throughput (%)	✔	✔
Summer throughput (%)	✔	✔
Fall throughput (%)	✔	✔
Hour per day in operation	✔	✔
Start time (hour)	✔	
Day per week in operation	✔	✔
Week per year in operation	✔	✔
Federal ID code (stack number)	✔	

HAP Inventory Data Reporting Elements (Continued)

Data Element	Major Sources	Area Sources
X coordinate (latitude)	✔	
Y coordinate (longitude)	✔	
Stack height	✔	
Stack diameter	✔	
Exit gas temperature	✔	
Exit gas velocity	✔	
Exit gas flow rate	✔	
SIC code	✔	
Boiler design capacity	✔	
Maximum design rate	✔	
Maximum nameplate capacity	✔	
Primary control efficiency (%)	✔	
Secondary control efficiency (%)	✔	
Control device type	✔	
Control efficiency		✔
Rule effectiveness (%)	✔	✔
Rule penetration (%)		✔

GLOSSARY

Activity rate/throughput - A measurable factor or parameter that is directly or indirectly related to the emissions of an air pollution source.

Area sources - Area sources collectively represent individual sources that have not been inventoried as specific point, mobile, or biogenic sources. These individual sources treated collectively as area sources are typically too small, numerous, or difficult to inventory using the methods for the other classes of sources.

Annual emissions - Actual emissions for a plant, point, or process, either measured or calculated.

Boiler design capacity - A measure of the size of a boiler, based on the reported maximum continuous steam flow. Capacity is calculated in units of MMBtu/hr.

Control device type - The name of the type of control device (e.g., wet scrubber, flaring, or process change).

Control efficiency - The emission reduction efficiency of a primary control device, which shows the amount of reduction of a particular pollutant from a process' emissions due to controls or material change. Control efficiency is usually expressed as a percentage or in tenths.

County/parish/reservation (FIPS) - Federal Information Placement System (FIPS). FIPS is the system of unique numeric codes developed by the government to identify states, counties, towns, and townships for the entire United States, Puerto Rico, and Guam.

Day/wk in operations - Days per week that the emitting process operates.

Emission factor - Ratio relating emissions of a specific pollutant to an activity or material throughput level.

Exit gas flow rate - Numeric value of stack gas flow rate.

Exit gas temperature - Numeric value of an exit gas stream temperature.

Exit gas velocity - Numeric value of an exit gas stream velocity.

Fall throughput(%) - Portion of throughput for the three Fall months (September, October, November).

Federal ID code (plant) - Unique codes for a plant or facility, containing one or more pollutant-emitting sources.

GLOSSARY (CONTINUED)

Federal ID code (point) - Unique codes for the point of generation of emissions, typically a physical piece of equipment.

Federal ID code (stack number) - Unique codes for the point where emissions from one or more processes are released into the atmosphere.

Heat content - The thermal heat energy content of a solid, liquid, or gaseous fuel. Fuel heat content is typically expressed in units of Btu/lb of fuel, Btu/gal of fuel, joules/kg of fuel, etc.

Hr/day in operations - Hours per day that the emitting process operates.

Maximum design rate - Maximum fuel use rate based on the equipment's or process' physical size or operational capabilities.

Maximum nameplate capacity - A measure of the size of a generator, and is put on the unit's nameplate by the manufacturer. The data element is reported in MW or KW.

Physical address - Street address of facility.

Point source - Point sources are large, stationary, identifiable sources of emissions that release pollutants into the atmosphere. A facility is defined as a point source by state or local air regulatory agencies when it annually emits more than a specified amount of a given pollutant; these "cut off" level definitions vary between state and local agencies.

Pollutant code - A unique code for each reported pollutant that has been assigned in the EIIP Data Model. Character names are used for criteria pollutants, while Chemical Abstracts Service (CAS) numbers are used for all other pollutants. Some states may be using SAROAD codes for pollutants, but these should be able to be mapped to the EIIP Data Model pollutant codes.

Rule effectiveness - The measure of a regulatory program to achieve all of the emission reductions possible, which reflects the assumption that controls are typically not 100 percent effective, because of equipment downtime, upsets, decreases in control efficiencies, and other deficiencies in emission estimates. RE is used to adjust the control efficiency.

Rule penetration - The percentage of an area source category that is covered by an applicable regulation.

SCC - Source category code. A process-level code that describes the equipment or operation emitting pollutants.

Source of activity rate/throughput data - Source of data from which activity rate/throughput was obtained.

GLOSSARY (CONTINUED)

Secondary control eff (%) - The emission reduction efficiency of a secondary control device, which shows the amount of reduction of a particular pollutant from a process' emissions due to controls or material change. Control efficiency is usually expressed as a percentage or in tenths.

SIC - Standard Industrial Classification code. U.S. Department of Commerce's categorization of businesses by their products or services.

Site name - The name of the facility.

Spring throughput(%) - Portion of throughput or activity for the three spring months (March, April, May). See the definition of Fall Throughput.

Stack diameter - Stack physical diameter.

Stack height - Stack physical height above the surrounding terrain.

Start date (inventory year) - The calendar year that the emissions estimates were calculated for and are applicable to.

State/providence/territory (FIPS) - Federal Information Placement System (FIPS). FIPS is the system of unique numeric codes developed by the government to identify states, counties, towns, and townships for the entire United States, Puerto Rico, and Guam.

Summer throughput(%) - Portion of throughput or activity for the three summer months (June, July, August). See the definition of Fall Throughput.

Winter throughput (%) - Portion of throughput or activity for the three winter months (December, January, February). See the definition of Fall Throughput.

Wk/yr in operation - Weeks per year that the emitting process operates.

Work Weekday - Any day of the week except Saturday or Sunday.

X coordinate (latitude) - East-west geographic coordinate of an object.

Y coordinate (longitude) - North-south geographic coordinate of an object.

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APPENDIX L

EXAMPLE CALCULATIONS

APPENDIX L

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INTRODUCTION

This appendix provides example calculations to show how emission estimation methods are used to develop an inventory. There are four basic approaches or methods that can be used to develop emissions estimates and inventories. These methods are:

- Mass balance;
- Emission factor;
- Stack test information; and
- Computer models.

Each example calculation shows how the method may be used for a specific emissions source category; it is intended that the reader use the information to apply the methods to other applicable source categories. The general format for each example calculation is as follows:

- Source category description;
- Emissions estimation method(s); and,
- Example calculation that shows how the method is used to develop an emissions estimate. For the computer model method, descriptions of several available models are provided rather than example calculations.

The emissions estimation methods described in this appendix are applicable to area sources and major (point) sources. The descriptions are summaries of the methods presented in the EIIP documents, (Volume II: Point Sources and Volume III: Area Sources). These documents describe emissions sources and, for each emission source, the available "preferred" and "alternative" methods for estimating emissions. In general, the preferred method is the most accurate and precise of the available estimation methodologies. Alternative methods are identified in the event it is not feasible for the agency performing the inventory to use the preferred approach. The inventory preparer should decide which method to use based on staffing, resource availability, and the time allowed for inventory development.

Inventory preparers are urged to review the EIIP documents to get more detailed information about the methods described here and to become aware of the other available methods. Because the activity data required for the mass balance, emission factor, and computer model approaches are sometimes collected by surveys, inventory preparers are urged to review the EIIP documents for guidance on conducting surveys and on data management procedures.

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EXAMPLE CALCULATION:

INDUSTRIAL SURFACE COATING

(MATERIAL BALANCE)

EXAMPLE CALCULATION: INDUSTRIAL SURFACE COATING

SOURCE CATEGORY DESCRIPTION

Surface coating operations are an integral part of the manufacturing phase for a variety of materials and products. Major types of surface coating activities include but are not limited to aircraft manufacturing, appliances, automobiles and light-duty trucks, flat wood product manufacturing, construction machinery, magnet wire, metal cans, metal coil, and metal and wood furniture

There are many different types of coatings that are used in the surface coating industry such as paints, varnishes, printing inks, polishes, sealers, etc. Typically, coatings provide protection or decoration to a substrate or surface. In a typical coating sequence, three types of coatings are used: a primer, an intermediate coat, and a topcoat. The majority of emissions that occur during surface coating are due to evaporation of the solvents contained in the coatings. The most common solvents are organic compounds such as ketones, esters, aromatics, and alcohols. To obtain or maintain certain application characteristics, solvents are also added to coatings immediately before use. Other ingredients of the coatings, such as metals and particulates, may also be emitted during coating operations.

Surface coating may be performed in a spray booth or in an open environment. Some previously open surface coating operations have been enclosed and the exhaust vented through a stack. Surface coatings may be applied manually or with automatic devices such as spray guns.

EMISSION ESTIMATION METHOD

Material balance utilizes the raw material usage rate to estimate the amount of pollutant emitted. Other information relating to material usage, such as fraction of the pollutant in the raw material and the amount of material recycled, disposed, or converted to another form, is also included in a material balance calculation. The material balance emission rate is calculated by multiplying the raw material used times the amount of pollutant in the coating, and subtracting the amount of pollutant recycled, disposed, or converted to another form.
Emissions are calculated using the following equation:

$$E_x = (Q_{in} - Q_{out}) * C_x$$

Where:

E_x = Total emissions of pollutant x
Q_{in} = Quantity of material entering the process
Q_{out}= Quantity of material leaving the process as waste, recovered, or in product
C_x = Concentration of pollutant x in the material applied

Example 1:

The following calculations show how Chromium VI (Cr VI) emissions from an industrial surface coating process are estimated.

Given: Coating usage = 500 gal/year
Cr(VI) concentration as shown on coating material MSDS = 0.08% by weight
Coating material density from MSDS sheet = 8 lb/gal
Transfer efficiency of spray gun = 40%
Control efficiency of control device = 80%

Mass of Cr(VI) entering spray booth =
Coating usage * coating density * Cr(VI) concentration

Thus,

Mass of Cr(VI) entering spray booth =
500 gal/yr * 8 lb/gal * 0.0008 lb Cr(VI)/lb coating = 3.2 lb/year of Cr(VI)

Mass of Cr(VI) transferred to final product through spraying =
Mass of Cr(VI) entering spray booth * transfer efficiency of spraying equiment

Thus,

Mass of Cr(VI) transferred to final product through spraying =
3.2 lb/yr * 40% = 1.28 lb/yr

Mass of Cr(VI) emitted = Mass of Cr(VI) entering spray booth - Mass of Cr(VI) transferred to final product through spraying

Thus,

Mass of Cr(VI) emitted = 3.2 lb/yr – 1.28 lb/yr = 1.92 lb/yr

Mass of Cr(VI) captured by control device = Mass of Cr(VI) emitted * control efficiency

Thus,

Mass of Cr(VI) captured by control device = 1.92 * 0.8 = 1.54 lb/yr

Mass of Cr(VI) emitted to the atmosphere =
Mass of Cr(VI) entering spray booth - mass of Cr(VI) transferred to final product through spraying - mass of Cr(VI) captured by control device

Thus,

Mass of Cr(VI) emitted to the atmosphere = 3.2 lb/yr – 1.28 lb/yr – 1.54 lb/yr = 0.38 lb/yr.

EXAMPLE CALCULATION: BOILERS

(STACK TEST INFORMATION; EMISSION FACTORS; MATERIAL BALANCE)

EXAMPLE CALCULATION: BOILERS

SOURCE CATEGORY DESCRIPTION

The boiler source category comprises sources that combust fuels to produce hot water and/or steam. Utility boilers utilize steam to generate electricity. Industrial boilers often generate steam for electrical power as well as process steam. Space heaters use the hot water for heating commercial and residential building space. Fuels typically used in boilers include coal, oil, and natural gas. In addition, liquified petroleum gas (LPG), process and waste gases, and wood wastes may be used. In general, boilers are categorized as follows:

Types of Boilers	Size
Utility	>100 MMBtu/hr
Industrial	10 - 250 MMBtu/hr
Commercial	<10 MMBtu/hr
Residential	<<10 MMBtu/hr

Auxiliary sources associated with boilers include fuel storage piles, fuel storage tanks, materials handling, and other sources of fugitive emissions. These sources are often overlooked and not reported as a part of the emission inventory. However, it is essential that these sources be considered in the emission inventory to develop a complete record of the emissions coming from the facility.

Combustion products from boiler operation can include partially oxidized hydrocarbons, acids such as hydrochloric acid, and organohalides such as dioxins and furans. The generation of undesirable combustion products is strongly influenced by fuel type, furnace type, firing configuration, and boiler operating conditions.

EMISSIONS ESTIMATION METHODS

The preferred methods for estimating emissions of most pollutants emitted from boilers are the use of site-specific stack test information and the use of emission factors. In addition, a mass balance approach based on fuel analysis is a preferred method for estimating emissions of metals.

Emissions Calculations Using Stack Sampling Data

Stack sampling test reports often provide emissions in terms of lb/hr. Annual emissions may be calculated from these data using Equation 1 and as shown in Example 2. Stack tests performed under a proposed permit condition or a maximum emissions rate may not accurately reflect the emissions that would result under normal operating conditions. Therefore, when using stack sampling test data to estimate emissions, tests should be conducted under "normal" operating conditions.

$$E_{tpy,x} = E_x * OpHrs/yr * \frac{ton}{2000\ lb} \qquad \text{(Equation 1)}$$

where:

$E_{tpy,x}$	=	Actual annual emissions in ton/yr of pollutant x
E_x	=	Emissions of pollutant x in lb/hr
OpHrs/yr	=	Operating hours per year

Example 2

This example shows how annual lead emissions can be calculated using Equation 1.

The results of three stack sampling test runs show that the average concentration of lead in the stack gas is 0.0005 pounds per dry standard cubic feet (lb/dscf) and the average stack gas volumetric flow rate is 51,700 dry standard cubic feet per minute (dscf/m). The lead emission rate is calculated as follows:

Lead emission rate	=	lead concentration * stack gas flow rate
	=	0.0005 lb/dscf * 51,700 dscf/m * 60 m/hr
	=	1,551 lb/hr

Emissions in tpy are based on 5,840 hr/yr operation and a lead emission rate of 1,551 lb/hr:

$E_{tpy,Pb}$	=	E_{Pb} * OpHrs/yr * ton/2000 lb
	=	1,551 * (5,840/2,000)
	=	4,529 tpy

Emissions Calculations Using Emission Factors

Emission factors are often used to estimate emissions from boilers. Annual emissions may be calculated from an emission factor and activity data using Equation 2 and as shown in Example 3.

$$E_{tpy,x} = EF_x * H_{in,ann} * \frac{ton}{2000\ lb} \qquad \text{(Equation 2)}$$

where:

$E_{tpy,x}$ = Actual annual emissions of pollutant x in ton/yr
Ef_x = Emission factor in lb/MMBtu of pollutant x
$H_{in,ann}$ = Annual heat input rate in MMBtu/yr

Example 3

Lead emissions estimate in tons per year (tpy), based on $4.84 * 10^6$ MMBtu/yr of heat input and an emission factor of 1.9 lb/MMBtu:

$$E_{tpy,Pb} = EF_{Pb} * H_{in,ann} \text{ ton/2,000 lb}$$
$$= 1.9 * 4.84 * 10^6/2{,}000$$
$$= 4{,}598 \text{ tpy}$$

Emission Calculations Using Mass Balance

A mass balance approach based on fuel analysis can be used to estimate emissions. The presence of certain elements in fuels may be used to predict their presence in emission streams. This includes toxic elements such as metals found in coal.

The basic equation used in fuel analysis emission calculations is:

where:

$$E_x = Q_f * C_x \quad \text{(Equation 3)}$$

E_x = Annual emissions of pollutant x, lb/yr
Q_f = Annual fuel usage, lb/yr
C_x = Weight percent of pollutant x in the fuel

For example, chromium emissions from oil combustion can be calculated based on the concentration of chromium in the oil. This approach assumes all of the chromium in the fuel is emitted as a pollutant. The application of this emission estimation technique is shown in Example 4.

Example 4

This example shows how chromium emissions can be calculated from oil combustion based on fuel analysis results and fuel flow information.

E_{cr} is calculated using Equation 3.

Q_f	=	46,000 lb/yr
Percent chromium in fuel	=	0.004
E_{cr}	=	$Q_f * C_{cr}$
	=	46,000 * 0.004%
	=	1.84 lb/hr

EXAMPLE CALCULATION:

ARCHITECTURAL SURFACE COATING

(MATERIAL BALANCE)

EXAMPLE CALCULATION: ARCHITECTURAL SURFACE COATING

SOURCE CATEGORY DESCRIPTION

Architectural surface coating operations consist of applying a thin layer of coating such as paint, paint primer, varnish, or lacquer to architectural surfaces, and the use of solvents as thinners and for cleanup. Architectural surface coatings protect the substrates to which they are applied from corrosion, abrasion, decay, ultraviolet light damage, and/or the penetration of water. Some architectural coatings also increase the aesthetic value of a structure by changing the color or texture of its surface. Architectural coatings are also important in construction of structures. Examples of the latter are concrete form release compounds, which prevent concrete from sticking to forms, and concrete curing compounds, which allow concrete to cure properly.

A wide range of coatings are used to cover both the interior and exterior surfaces of architectural structures. The majority of architectural surface coatings are applied by homeowners and painting/surface coating contractors to domestic, industrial, institutional, and governmental structures throughout a geographic area.

Because the coated architectural surface dries or cures in the ambient air, the use of exterior architectural coatings may be limited to periods when local climatic conditions facilitate acceptable coating curing. Although interior coating applications are less influenced by outdoor conditions, complete curing of these coatings also can be hampered by cool, moist weather (i.e., when evaporation rates are reduced).

VOCs that are used as solvents in the coatings are emitted during application of the coating and as the coating dries.** The amount of coating used and the VOC content of the coating are the factors that primarily determine emissions from architectural surface coating operations. Secondary sources of VOC emissions are from the solvents used to clean the architectural coating application equipment and VOC released as reaction byproducts while the coating drys and hardens. VOC emitted from this chemical reaction is determined by the resins used in a particular coating. The VOC emitted from any of these sources could include HAPs.

Structural maintenance practices indirectly influence VOC emissions by controlling the total coating consumption on a long-term basis. Regular inspection and maintenance programs can be used to reduce the need for entire surface recoating.

The preferred method for calculating emission estimates from architectural surface coating is a mass balance approach based on information collected by a survey of coating manufacturers in the region, or distributors in the area. A specific discussion of surveys for area sources is provided in Volume III of the EIIP series. A general approach for a survey of suppliers or

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** There are many solvents that may be used in architectural surface coating operations. Some compounds may be considered nonreactive and should not be counted in an ozone (VOC) inventory, but would need to be quantified for air modeling, or HAP inventory.

manufacturers of architectural coatings uses five steps: (1) survey planning, (2) survey preparation, (3) survey distribution, (4) survey compilation and scaling, and (5) emission estimation.

Emission estimation calculations involve the calculation of emissions of individual pollutants, and then the application of any necessary spatial or temporal adjustments. Because the application of architectural surface coating is generally defined as an area source, there should not be a need to subtract point source emission estimates from the total. However, there may be cases when emission estimates from this category may be estimated as one of many processes occurring at a point source for the purposes of permitting and emission tradeoffs. These emissions must be identified and then subtracted from the area source estimates.

The equation below can be used to estimate the total amount of pollutant (P) emitted in the inventory area from architectural surface coating operations.

$$ASE_P = \sum_{c=1}^{C} \sum_{s=1}^{S} TAC_{c,s} \cdot SC_{c,s} \cdot F_{P,s}$$

where:

ASE_P	=	Total emissions of pollutant (P) from architectural surface coating operations, for all coatings (C) with all solvents (S)
$TAC_{S,C}$	=	Total architectural surface coating consumed in the inventory area for each coating (c) with each solvent (s) containing pollutant (P)
$SC_{c,s}$	=	Amount of solvent (s) in each coating (c)
$F_{P,s}$	=	Fraction of pollutant (P) in each solvent (s)

Spatial allocation to individual counties or other inventory area units can be done using building square footage in the inventory area, land usage data, or population.

Temporal allocation may be necessary if the inventory requires seasonal or daily emission estimates.

Example 5 shows how formaldehyde emissions may be calculated for architectural surface coating.

Example 5:

This example shows how formaldehyde emissions from architectural surface coating can be calculated.

Formaldehyde is reported in a survey of distributors in various weight percents for some formulations of primers, varnishes and waterproofing sealers. Reported weight percents for these coating types, and the amount delivered to the inventory area, in pounds, are presented below.

Coating Type	Formaldehyde Weight %	Amount of Coating Distributed (lb)
Primers	1.60	304.50
	17.50	47.85
	0.55	52.20
	7.50	5.22
Varnishes	0.55	845.50
	0.65	1330.00
Waterproofing Sealers	0.55	8.96

Formaldehyde emissions are calculated for varnishes as follows:

Emissions from Varnishes = [842.5 lb * 0.55%] + [1330 lb * 0.65%]

= 4.65 + 8.645

= 13.295 lb Formaldehyde

Emissions are calculated for waterproofing and primers in the same manner, and all emission estimates are summed for the total formaldehyde estimate.

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EXAMPLE CALCULATION: WASTEWATER COLLECTION AND TREATMENT

(COMPUTER MODEL)

EXAMPLE CALCULATION: WASTEWATER COLLECTION AND TREATMENT

SOURCE CATEGORY DESCRIPTION

Wastewater streams are collected and treated in a variety of ways. Many of these collection and treatment system units are open to the atmosphere and allow organic-containing wastewaters to contact ambient air. Whenever this happens, there is a potential for VOC emissions. Many of the individual VOCs are also HAPs. The organic pollutants volatilize in an attempt to exert their equilibrium partial pressure above the wastewater. In doing so, the organics are emitted to the ambient air surrounding the collection and treatment units. The magnitude of VOC emissions depends greatly on many factors such as the physical properties of the pollutants, pollutant concentration, flow rate, the temperature of the wastewater, and the design of the individual collection and treatment units. All of these factors, as well as the general scheme used to collect and treat facility wastewater, have a major effect on VOC emissions.

Collection and treatment schemes are facility specific. The flow rate and organic composition of wastewater streams at a particular facility are functions of the processes used. The wastewater flow rate and composition, in turn, influence the sizes and types of collection and treatment units that must be employed at a given facility.

EMISSIONS ESTIMATION METHOD

The preferred method for estimating emissions from wastewater collection and treatment (WWCT) systems is the use of computer-based emissions models. There are numerous emissions estimation models available to calculate emissions from WWCT. Differences in the models include applicability to the types of collection and treatment systems, the level of site-specific data accepted, the level of default data provided, and whether or not the models account for the full spectrum of pollutant pathways (volatilization, biodegradation, and sorption). Models may also contain different default data (e.g., Henry's Law constants, biodegradation rate constants).

Many of these models allow for user input of data. The use of site-specific data is always preferred over the use of default data. Typically, the types of data needed are the chemical and physical properties of the wastewater stream, as well as collection and treatment device parameters. At a minimum, wastewater stream characteristics (HAP constituents) are needed at the inlet to the treatment plant or collection device. However, if data are available for various points within the treatment plant, a more accurate emissions estimate may be obtained.

In order to obtain a reliable emissions estimate using a software model, the modeler needs to understand both the configuration and wastewater stream characteristics of the collection and/or treatment units, as well as the emissions estimation algorithm used by the model. Not all models can handle all collection/treatment devices and results are likely to vary between models. A more accurate emissions estimate will result if the user has confidence in the input data and understands the emission estimation approach used by the model.

NOTE: A brief summary of some currently available models is provided below. Work is ongoing to improve some of the current models and to develop new ones. The reader should consult with their state regulatory agency for guidance on the selection and use of an appropriate model.

WATER8/CHEMDAT8 (Treatment and Collection)

WATER8 is a publicly available computer program model developed by EPA that models the fate of organic compounds in various wastewater treatment units, including collection systems, aerated basins, and other units. WATER8 contains useful features such as the ability to link treatment units to form a treatment system, the ability for recycle among units, and the ability to generate and save site-specific compound properties. WATER8 has a database with compound-specific data for over 950 chemicals. The WATER8 model is publicly available on the CHIEF bulletin board system. Many of the emissions models contained in WATER8 are also presented in spreadsheet form in CHEMDAT8.

CINCI (EPA - Cincinnati Model) - *Integrated Model for Predicting the Fate of Organics in Wastewater Treatment Plants* (Treatment Only)

This model was developed with support from the EPA Risk Reduction Engineering Laboratory. The physical properties database of the model includes 196 chemicals and metals, Henry's Law constants, sorption coefficients, biodegradation rate constants, and diffusivities. Removal mechanisms included are stripping/volatilization, stripping, surface volatilization, sorption, and biodegradation. Unit operations included are primary treatment followed by secondary treatment with sludge recycle, secondary treatment with sludge recycle, and secondary treatment without sludge recycle. The model is written in FORTRAN and has three built-in default cases. CINCI is available at no charge through the EPA Risk Reduction Engineering Laboratory.

APPENDIX M

SOURCE TEST METHODS FOR AIR TOXICS

Source Test Methods For Air Toxics

CAS Number	Chemical Name	Primary EPA Methods* Sampling	Analytical Methods*	Applicable Sampling Method* Stationary Source Analysis Non-Point Emissions
75070	Acetaldehyde	Draft 0011	Draft 8315	TO-5, TO-11
60355	Acetamide	0010	8270	TO-13
75058	Acetonitrile	18	18	TO-14
98862	Acetophenone	0010	8270	TO-5, TO-13
53963	2-Acetylaminofluorene	0010	8270	TO-13
107028	Acrolein	Draft 0011	Draft 8315	TO-5, TO-11
79061	Acrylamide	0010	8270	TO-13
79107	Acrylic acid	0010	8270	TO-13
107131	Acrylonitrile	0030	5040, Draft 5041	TO-1, TO-14
107051	Allyl chloride	0030	5040, Draft 5041	TO-1, TO-2, TO-14
92671	4-Aminobiphenyl	0010	8270	TO-13
62533	Aniline	0010	8270	TO-13
90040	o-Anisidine	0010	8270	TO-13
1332214	Asbestos	CARB 427	CARB 427	CARB 427, NIOSH 7400
71432	Benzene	0030	5040, Draft 5041	TO-1, TO-2, TO-14
92875	Benzidine	0010	8270	TO-13
98077	Benzotrichloride			TO-1, TO-13
100447	Benzyl chloride	0010	8270	TO-1, TO-13
92524	Biphenyl	0010	8270	TO-13
117817	Bis(2-ethylhexyl)phthalate (DEHP)	0010	8270	TO-13
542881	Bis(chloromethyl)ether	18	18	TO-1, TO-14
75252	Bromoform	0010	8270	TO-1, TO-14
106990	1,3-Butadiene	18	18	TO-1, TO-2, TO-14
156627	Calcium cyanamide			
105602	Caprolactam	0010	8270/632	TO-13
133062	Captan	0010	8270	TO-4, TO-10

Source Test Methods For Air Toxics (Continued)

CAS Number	Chemical Name	Primary EPA Methods* Sampling	Analytical Methods*	Applicable Sampling Method* Stationary Source Analysis Non-Point Emissions
63252	Carbaryl	0010	8318	TO-13
75150	Carbon disulfide	0030	5040, Draft 5041	TO-1
56235	Carbon tetrachloride	0030	5040, Draft 5041	TO-1, TO-2, TO-14
463581	Carbonyl sulfide	15	15	TO-1, TO-14
120809	Catechol	0010	8270	TO-13
133904	Chloramben	0010	515/615	TO-13
57749	Chlordane	0010	8270	TO-4, TO-10
7782505	Chlorine	0050,0051	9057	OSHA ID-101
79118	Chloroacetic acid	0010	8270	TO-13
532274	2-Chloroacetophenone	0010	8270	TO-5, TO-11, TO-13
108907	Chlorobenzene	0010, 0030	8270, 5040, Draft 5041	TO-1, TO-14
510156	Chlorobenzilate	0010	8270	TO-13
67663	Chloroform	0030	5040, Draft 5041	TO-1, TO-2, TO-14
107302	Chloromethyl methyl ether	0030	5040, Draft 5041	TO-1, TO-14
126998	Chloroprene	0030	5040, Draft 5041	TO-1, TO-14
1319773	Cresylic acid	0010	8270	TO-8, TO-13
95487	o-Cresol	0010	8270	TO-8, TO-13
108394	m-Cresol	0010	8270	TO-8, TO-13
106445	p-Cresol	0010	8270	TO-8, TO-13
98828	Cumene	0010	8270	TO-1, TO-13, TO-14
94757	2,4-D, salts and esters	0010	515/615	TO-10
3547044	DDE	0010	8270	TO-4, TO-10
334883	Diazomethane			NIOSH 2515
132649	Dibenzofurans	23	23	TO-9
96128	1,2-Dibromo-3-chloropropane	0010	8270	TO-13
84742	Dibutylphthalate	0010	8270	TO-13

Source Test Methods For Air Toxics (Continued)

CAS Number	Chemical Name	Primary EPA Methods* Sampling	Analytical Methods*	Applicable Sampling Method* Stationary Source Analysis Non-Point Emissions
106467	1,4-Dichlorobenzene(p)	0010	8270	TO-1, TO-13, TO-14
91941	3,3-Dichlorobenzidene	0010	8270	TO-13
111444	Dichloroethyl ether	0010	8270	TO-13
542756	1,3-Dichloropropene	0030	5040, Draft 5041	TO-1, TO-14
62737	Dichlorvos	0010	8270	TO-13
111422	Diethanolamine	0010	8270	TO-13
121697	N,N-Diethyl aniline (N,N-Dimethylaniline)	0010	8270	TO-13
64675	Diethyl sulfate	0010	8270	TO-13
119904	3,3-Dimethoxybenzidine	0010	8270	TO-13
60117	Dimethyl aminoazobenzene	0010	8270	TO-13
119937	3,3'-Dimethyl benzidine	0010	8270	TO-13
79447	Dimethyl carbamoyl chloride	0010	531	TO-13
68122	Dimethyl formamide	0010	8270	TO-13
57147	1,1-Dimethyl hydrazine	0030	5040, Draft 5041	TO-1, TO-14
131113	Dimethyl phthalate	0010	8270	TO-13
77781	Dimethyl sulfate	0010	8270	TO-13
534521	4,6-Dinitro-o-cresol, and salts	0010	8270,515/615	TO-13
51285	2,4-Dinitrophenol	0010	8270	TO-13
121142	2,4-Dinitrotoluene	0010	8270	TO-13
123911	1,4-Dioxane (1,4-Diethyleneoxide)	0010	8270	TO-1, TO-14
122667	1,2-Diphenylhydrazine	0010	8270	TO-13
106898	Epichlorohydrin (1,Chloro-2,3-epoxypropane)	0010	8270	TO-13
106887	1,2-Epoxybutane	0030	5040, Draft 5041	TO-1, TO-14
140885	Ethyl acrylate	0030	5040, Draft 5041	TO-1, TO-14
100414	Ethyl benzene	0010	8270	TO-1, TO-14

Source Test Methods For Air Toxics (Continued)

CAS Number	Chemical Name	Primary EPA Methods* Sampling	Analytical Methods*	Applicable Sampling Method* Stationary Source Analysis Non-Point Emissions
51796	Ethyl carbamate (Urethane)	0010	8270	TO-13
75003	Ethyl chloride (Chloroethane)	0030	5040, Draft 5041	TO-1, TO-2, TO-14
106934	Ethylene dibromide (Dibromoethane)	0010	8270	TO-1, TO-13, TO-14
107062	Ethylene dichloride (1,2-Dichloroethane)	0030	5040, Draft 5041	TO-1, TO-2, TO-14
107211	Ethylene glycol	0010	8270	TO-13
151564	Ethylene imine (Aziridine)	0030	5040, Draft 5041	TO-1, TO-14
75218	Ethylene oxide	18, CARB 431	18, CARB 431	TO-14
96457	Ethylene thiourea	0010	632	TO-13
75343	Ethylidene dichloride (1,1-Dichloroethane)	0030	5040, Draft 5041	TO-1, TO-14
50000	Formaldehyde	Draft 0011	Draft 8315	TO-5, TO-11
76448	Heptachlor	0010	8270	TO-4, TO-10
118741	Hexachlorobenzene	0010	8270	TO-13
87683	Hexachlorobutadiene	0010	8270	TO-1, TO-13, TO-14
77474	Hexachlorocyclopentadiene	0010	8270	TO-13
67721	Hexachloroethane	0010	8270	TO-1, TO-13, TO-14
822060	Hexamethylene-1,6-diisocyanate	0010	8270	TO-13
680319	Hexamethylphosphoramide	0010	632	TO-13
110543	Hexane	0030	5040, Draft 5041	TO-1, TO-14
302012	Hydrazine	18	18	18
7647010	Hydrochloric acid	0050, 0051	9057	18, 26
7664393	Hydrogen fluoride (Hydrofluoric acid)	13A or B	13A or B	14, 18
123319	Hydroquinone	0010	8270	TO-13
78591	Isophorone	0010	8270	TO-5, TO-11, TO-13
58899	Lindane (all isomers)	0010	8270	TO-4, TO-10
108316	Maleic anhydride	0010	8270	TO-13
67561	Methanol	18	18	TO-14

Source Test Methods For Air Toxics (Continued)

CAS Number	Chemical Name	Primary EPA Methods* Sampling	Analytical Methods*	Applicable Sampling Method* Stationary Source Analysis Non-Point Emissions
72435	Methoxychlor	0010	8270	TO-4, TO-10, TO-13
74839	Methyl bromide (Bromomethane)	0030	5040, Draft 5041	TO-1, TO-2, TO-14
74873	Methyl chloride (Chloromethane)	0030	5040, Draft 5041	TO-1, TO-2, TO-14
71556	Methyl chloroform (1,1,1-Trichloroethane)	0030	5040, Draft 5041	TO-1, TO-2, TO-14
78933	Methyl ethyl ketone (2-Butanone)	Draft 0011	8315	TO-1, TO-5, TO-11, TO-14
60344	Methyl hydrazine	0030	5040, Draft 5041	TO-1, TO-14
74884	Methyl iodide (lodomethane)	0030	5040, Draft 5041	TO-1, TO-14
108101	Methyl isobutyl ketone (Hexone)	Draft 0011	Draft 8315	TO-1, TO-5, TO-11, TO-14
624839	Methyl isocyanate	0030	5040, Draft 5041	TO-1, TO-14
80626	Methyl methacrylate	0030	5040, Draft 5041	TO-1, TO-14
1634044	Methyl tert butyl ether	0010	8270	TO-1, TO-5, TO-11, TO-14
101144	4,4-Methylene bis (2-chloroaniline)	0010	8270	TO-13
75092	Methylene chloride (Dichloromethane)	0030	5040,Draft 5041	TO-1, TO-2, TO-14
101688	Methylene diphenyl diisocyanate (MDI)	0010	8270	TO-13
101779	4,4'-Methylenedianiline	0010	8270	TO-13
91203	Naphthalene	0010	8270	TO-13
98953	Nitrobenzene	0010	8270	TO-1, TO-14
92933	4-Nitrobiphenyl	0010	8270	TO-13
100027	4-Nitrophenol	0010	8270	TO-13
79469	2-Nitropropane	0010	8270	TO-1, TO-13, TO-14
684935	N-Nitroso-N-methylurea	0010	8270	TO-13
62759	N-Nitrosodimethylamine	0010	8270	TO-1, TO-7, TO-13
59892	N-Nitrosomorpholine	0010	8270	TO-7, TO-13
56382	Parathion	0010	8270	TO-4, TO-10
82688	Pentachloronitrobenzene (Quintobenzene)	0010	8270	TO-13
87865	Pentachlorophenol	0010	8270	TO-13

Source Test Methods For Air Toxics (Continued)

CAS Number	Chemical Name	Primary EPA Methods* Sampling	Analytical Methods*	Applicable Sampling Method* Stationary Source Analysis Non-Point Emissions
108952	Phenol	0010	8270	TO-13
106503	p-Phenylenediamine	0010	8270	TO-13
75445	Phosgene			TO-6
7803512	Phosphine	Draft 0012	Draft 0012	Draft 0012, 18
7723140	Phosphorus	Draft 0012	Draft 0012	Draft 0012
85449	Phthalic anhydride	0010	8270	TO-13
1336363	Polychlorinated biphenyls (Aroclors)	0010	680	TO-13 with 680 or 8080
1120714	1,3-Propane sultone	0010	8270	TO-13
57578	beta-Propiolactone	0010	8270	TO-13
123386	Propionaldehyde	Draft 0011	Draft 8315	TO-5, TO-11
114261	Propoxur (Baygon)	0010	8318	TO-13
78875	Propylene dichloride (1,2-Dichloropropane)	0030	5040, Draft 5041	TO-1, TO-14
75569	Propylene oxide	0030	5040, Draft 5041	TO-1, TO-14
75558	1,2-Propylenimine(2-Methyl aziridine)	0030	5040, Draft 5041	TO-1, TO-14
91225	Quinoline	0010	8270	TO-13
106514	Quinone	Draft 0011	Draft 8315	TO-5, TO-11
100425	Styrene	0010	8270	TO-1, TO-14
96093	Styrene oxide	0010	8270	TO-13
1746016	2,3,7,8-Tetrachlorodibenzo-p-dioxin	23	23	TO-9
79345	1,1,2,2-Tetrachloroethane	0010	8270	TO-1, TO-14
127184	Tetrachloroethylene (Perchloroethylene)	0030	5040, Draft 5041	TO-1, TO-14
7550450	Titanium tetrachloride	Draft 0012	Draft 0012	Draft 0012, 13A or B
108883	Toluene	0030, 0010	5040, Draft 5041, 8270	TO-1, TO-2, TO-14
95807	2,4-Toluene diamine	0010	8270	TO-13
584849	2,4-Toluene diisocyanate	0010	8270	TO-13
95534	o-Toluidine	0010	8270	TO-13

Source Test Methods For Air Toxics (Continued)

CAS Number	Chemical Name	Primary EPA Methods* Sampling	Analytical Methods*	Applicable Sampling Method* Stationary Source Analysis Non-Point Emissions
8001352	Toxaphene (chlorinated camphene)	0010	8270	TO-4, TO-10
120821	1,2,4-Trichlorobenzene	0010	8270	TO-1, TO-13
79005	1,1,2-Trichloroethane	0030	5040, Draft 5041	TO-1, TO-14
79016	Trichloroethylene	0030	5040, Draft 5041	TO-1, TO-2, TO-14
95954	2,4,5-Trichlorophenol	0010	8270	TO-13
88062	2,4,6-Trichlorophenol	0010	8270	TO-13
121448	Triethylamine	0030	5040, Draft 5041	TO-13
1582098	Trifluralin	0010	8270	TO-4, TO-10
540841	2,2,4-Trimethylpentane	0030	5040, Draft 5041	TO-1, TO-14
108054	Vinyl acetate	0030	5040, Draft 5041	TO-1, TO-14
593602	Vinyl bromide	0030	5040, Draft 5041	TO-1, TO-2, TO-14
75014	Vinyl chloride	0030	5040, Draft 5041	TO-1, TO-2, TO-14
75354	Vinylidene chloride (1,1-Dichloroethylene)	0030	5040, Draft 5041	
1330207	Xylenes (isomers and mixture)	0010	8270	TO-1, TO-14
95476	o-Xylenes	0010	8270	TO-1, TO-14
108383	m-Xylenes	0010	8270	TO-1, TO-14
106423	p-Xylenes	0010	8270	TO-1, TO-14
	Antimony Compounds	Draft 0012	Draft 0012	Draft 0012
	Arsenic Compounds (inorganic including arsine)	Draft 0012	Draft 0012	Draft 0012
	Beryllium Compounds	Draft 0012	Draft 0012	Draft 0012
	Cadmium Compounds	Draft 0012	Draft 0012	Draft 0012
	Chromium Compounds	Draft 0012	Draft 0012	Draft 0012
	Cobalt Compounds	Draft 0012	Draft 0012	Draft 0012
	Coke Oven Emissions	0010	8310	109 (Visible Emissions)
	Cyanide Compounds	(modified) 6	NIOSH 7904	NIOSH 7904/9010,9012

Source Test Methods For Air Toxics (Continued)

CAS Number	Chemical Name	Primary EPA Methods* Sampling	Analytical Methods*	Applicable Sampling Method* Stationary Source Analysis Non-Point Emissions
	Glycol ethers	0010	8270	TO-13
	Lead Compounds	Draft 0012	Draft 0012	Draft 0012
	Manganese Compounds	Draft 0012	Draft 0012	Draft 0012
	Mercury Compounds	Draft 0012	Draft 0012	Draft 0012
	Fine Mineral Fibers	CARB 427	CARB 427	CARB 427
	Nickel Compounds	Draft 0012	Draft 0012	Draft 0012
	Polycyclic Organic Matter	CARB 429	CARB 429	TO-13
	Radionuclides (including radon)	114	114	0020/EPA Docket No.A-79-11
	Selenium Compounds	Draft 0012	Draft 0012	Draft 0012

NOTE: For all listings above which contain the word "compounds" and for gylcol ethers, the following applies: Unless otherwise specified, these listings are defined as including any unique chemical substance that contains the named chemical (i.e., antimony, arsenic, etc.) as part of that chemical's infrastructure

METHODS REFERENCE:

TO-XX	=	Reference "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air," EPA-600/4-89-017 (Supplements: 600/4-87-006, 600/4-87-013)
NIOSH-X	=	Reference "NIOSH Manual of Analytical Methods, Part 1: NIOSH Monitoring Methods, Volume 1,"U.S. Dept. of Health, Education and Welfare, NIOSH, Cincinnati, Ohio, Revised 1985.
XXXX	=	Reference "Test Methods for Evaluating Solid Waste," Third Edition, Report No. SW-846, US EPA, OSWER, Washington, DC, 1986.
XXX	=	EPA reference methods can be found in various publications including: CFR 40 Part 60 Appendix A; CFR 40 Part 60Appendix B; "Standards of Performance for New Stationary Sources," US EPA 340/1-77-015; 56 FR 5758, other EPA-EMSL Reports.
CARB-XXX	=	"Stationary Source Test Methods, Volume III: Methods for Determining Emissions of Toxic Air Contaminants from Stationary Sources," State of California Air Resources Board, Monitoring and Laboratory Div., Sacramento, CA, 1989.
OSHA	=	OSHA Method ID-101 used to determine chlorine in workplace atmospheres.
*	=	Data extracted from EPA publication EPA-450/4-91-021, "Screening Methods for the Development of Air Toxics Emission Factors." September, 1991.

APPENDIX N

LIST OF EMISSION FACTOR RESOURCES

APPENDIX N

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LIST OF EMISSION FACTOR RESOURCES

Landfill Air Emissions Estimation Model (LAEEM)

The Landfill Air Emissions Estimation Model (LAEEM) was developed by the Clean Air Technology Center (CATC). The model can be used to estimate emission rates for methane, carbon dioxide, nonmethane organic compounds, and individual toxic air pollutants from landfills. The system allows the user to enter specific information regarding the characteristics and capacity of an individual landfill and to project the emissions of methane, CO, nonmethane organic compounds, and individual HAPs over time using the Scholl Canyon decay model for landfill gas production estimation. The Scholl Canyon Model is a first-order decay equation that uses site-specific characteristics for estimating the gas generation rate. In the absence of site-specific data, the program provides conservative default values. The user also may tailor decay rate characteristics on an individual basis. An integrated decay rate constant calculator is provided for landfills that may be operating a gas recovery system to allow more accurate assessments of decay attributes. Outputs may be reviewed in either tabular or graphical forms. A help system is also provided with information on the model operation as well as details on assumptions and defaults used by the system. For additional information contact the EPA's Air Pollution Prevention and Control Division at (919) 541-2709. The model can be downloaded from the World Wide Web through EPA's TTN web page at *http://www.epa.gov/ttn/catc/products.html#software*.

TANKS

TANKS is a Windows-based computer software program that computes estimates of VOC emissions from fixed- and floating-roof storage tanks based on the emission estimation procedures from Chapter 7 of *AP-42*, plus recent updates from the American Petroleum Institute. The TANKS program employs a chemical database of over 100 organic liquids and meteorology data from over 250 cities in the United States. The user may add new chemicals and cities to their version of the database. The tank types addressed in the program include vertical and horizontal fixed roof tanks, and internal and external floating roof tanks. The tank contents can consist of single-component liquid or a multicomponent mixture. TANKS provides three ways to "speciate" stored liquid mixtures to estimate the emissions of individual components. TANKS is available through the EPA's TTN web page at *http://www.epa.gov/ttn/chief/tanks.html*.

WATER8

WATER8 is an analytical model for estimating compound-specific air emissions from wastewater collection & treatment systems including aerated basins, and other units. WATER8 contains useful features such as the ability to link treatment units to form a treatment system, the ability for recycle among units, and the ability to generate and save site-specific compound properties. WATER8 has a database with compound-specific data for over 950 chemicals. WATER8 is available through the EPA's TTN web page at *http://www.epa.gov/ttn/chief/software.html#water8.*

CHEMDAT8

CHEMDAT8 is a Lotus 1-2-3 spreadsheet that includes analytical models for estimating emissions from treatment, storage and disposal facility (TSDF) processes. The original models include disposal impoundments, closed landfills, land treatment facilities, and aeration and nonaeration impoundment processes.

The models in CHEMDAT8 can be applied to other types of TSDF processes besides those contained in the original design. The nonaerated impoundment model in CHEMDAT8 can estimate emissions from storage surface impoundments and open-top wastewater treatment tanks. The CHEMDAT8 aerated impoundment model may be used for predicting emissions from surface treatment impoundments and aerated wastewater treatment tanks. The land treatment model in CHEMDAT8 can estimate emissions from land treatment soil, open landfills, and wastepiles. Emissions from an oil film surface in a land treatment facility or an oil film on surface impoundments can be predicted via the oil film model in CHEMDAT8. When a CHEMDAT8 model is not available to predict emissions, the equations shown in the reports that provide the background to the model can be used to perform hand calculations of emissions.

This eighth version of the CHEMDAT spreadsheet contains several major operational modifications. In CHEMDAT8, the user can select a subset of target compounds for investigation. The user can also specify which TSDF processes are to be considered during a session. These two selections improve the efficiency of CHEMDAT8 relative to some of the earlier versions by minimizing storage requirements as well as actual loading and execution time.

Default input parameters in the CHEMDAT8 diskette demonstrate example calculations. However, the input parameters can be changed to reflect different TSDF characteristics and then recalculate emissions under these modified conditions. The list of 60 compounds currently in CHEMDAT8 can be augmented by an additional 700 chemicals. Procedures for introducing data for additional compounds into CHEMDAT8 are described in the supporting documentation report. CHEMDAT8 is available through the EPA's TTN web page at *http://www.epa.gov/ttn/chief/software.html#water8.*

CINCI

CINCI is an integrated model for predicting the fate of organics in wastewater treatment plants. CINCI was developed with support from the EPA Risk Reduction Engineering Laboratory. The physical properties database of the model includes 196 chemicals and metals, Henry's Law constants, sorption coefficients, biodegradation rate constants, and diffusivities. Removal mechanisms included are stripping/volatilization, stripping, surface volatilization, sorption, and biodegradation. Unit operations included are primary treatment followed by secondary treatment with sludge recycle, secondary treatment with sludge recycle, and secondary treatment without sludge recycle. The model is written in FORTRAN and has three built-in default cases. CINCI is available at no charge through the EPA Risk Reduction Engineering Laboratory.

Locating and Estimating Air Emissions from Sources of (Source Category) or (Substance) Documents

This report series (known as *L&E* documents) characterizes the source categories for which emissions of a toxic substance have been identified. Specifically, each volume includes general descriptions of the emitting processes, identifying potential release points and emission factors.

L&E documents make use of *AP-42* emission factors where applicable, and they also revise or supplement those emission factors when necessary to present the most complete assessment of the sources of the specific toxic air pollutant. Paper copies of any of the *L&E* series documents may be ordered free of charge from the Info CHIEF help desk at (919) 541-5285. *L&E* documents can be downloaded from the World Wide Web through EPA's TTN web page at *http://www.epa.gov/ttn/chief/ap42etc.html#LE*. A complete list of all *L&E* documents is included in Appendix P.

Compilation of Air Pollutant Emission Factors (AP-42)

EPA is continuously updating *AP-42* to include available HAP emission factors for the most common emission source categories. Each AP-42 emission factor is given a rating from A through E, with A being the best. A factor's rating is a general indication of the reliability, or robustness, of that factor. This rating is assigned based on the estimated reliability of the tests used to develop the factor and on both the amount and the representative characteristics of those data. Because ratings are subjective and only indirectly consider the inherent scatter among the data used to calculate factors, the ratings should be seen only as approximations. A rating should be considered an indicator of the accuracy and precision of a given factor being used to estimate emissions from a large number of sources. This indicator is largely a reflection of the professional judgment of *AP-42* authors and reviewers concerning the reliability of any estimates derived with these factors. Up-to-date sections of *AP-42* can be downloaded off the World Wide Web through OAQPS' TTN Web site at *http://www.epa.gov/ttn/chief/ap42etc.html*.

Factor Information Retrieval (FIRE) Data System

FIRE is a database management system containing:

- EPA's recommended emission estimation factors for criteria pollutants and HAPs;
- Information about industries, their emitting processes, and chemicals emitted;
- All EPA point and area SCCs through April, 1998;
- Easy access to criteria and HAP emission factors obtained from *AP-42, L&E* series documents, factors derived from state-reported test data, and factors taken from literature searches;

- Capability for users to browse through records in the database or to select specific emission factors by source category name or source classification code (SCC), by pollutant name or CAS number, or by control device type or code.

FIRE Version 6.01 (released May, 1998) is a user-friendly, menu-driven Windows® program that can run under Windows® Version 3.1, 95 or Windows® NT. FIRE can be downloaded off the World Wide Web through OAQPS' TTN Web site at *http://www.epa.gov/ttn/chief/fire.html*. FIRE is also available on the Air CHIEF, a compact disc read-only memory (CD- ROM) and can be obtained by calling the Info CHIEF Help Desk at (919) 541-5285.

Air Clearinghouse for Inventories and Emission Factors (Air CHIEF) CD-ROM

Air CHIEF CD-ROM format, gives access to air emission data specific to estimating the types and quantities of pollutants that may be emitted from a wide variety of sources. Updated annually, Air CHIEF offers thousands of pages contained in some of EPA's most widely used documents. This most recent version of Air CHIEF contains many enhancements, such as linking between related documents, Web links directly to the CHIEF Web site for easy access to the most recent updates, and enhanced full-CD searching. The Adobe Acrobat® software included on the CD allows for easy browsing of all information or locating specific information by conducting keyword searches by pollutant, source category, SCC, or SIC code. Some of the databases included on Air CHIEF version 5.0 are: (1) *AP-42*; (2) *L&E* documents; (3) *EIIP* documents (current through August 1997); and (5) FIRE.

Air CHIEF version 5.0 is available for distribution by GPO for $15.00 (Stock Number: 055-000-00580-0) and can be ordered by calling GPO at (202) 512-1800, or by ordering online through OAQPS' TTN Web site at *http://www.epa.gov/ttn/chief/airchief.html#order*. Version 6.0 will be released in November 1998.

Unified Air Toxics Web site (UATW)

UATW was established jointly by the EPA and STAPPA/ALAPCO as a database of facility permit and source test information submitted by state and local agencies to EPA. UATW collects, classifies, and disseminates information submitted by federal, state and local agencies regarding their air toxics programs. Information contained at this site includes:

- Emission factors, emissions test data, and source category identifications;
- Background information on air toxics and their effect on health;
- Descriptions of the various subsections of Section 112 of the CAA;
- The original Section 112 list of HAPs, the list of modifications to the original Section 112 list, and the most current list of HAP;

- List of original source categories and subcategories defined in Section 112 of the CAA, and the most current list;

- On-line access to miscellaneous information (basic facts, regulatory development, and educational and training resources) relating to air toxics, including publications dealing with air toxics from small businesses;

- Gateway to the on-line Toxics Release Inventory;

- Links to other EPA offices web pages;

- Links to air toxics rules, rule development activities, implementation information, and comprehensive MACT rule specific information including promulgation dates;

- Other air toxics rules, policies, guidance, studies, reports and initiatives; and

- Lists of contact names and phone numbers, allowing the user the opportunity to get more specifics directly from the supplying agencies.

UATW can be accessed on the World Wide Web through OAQPS' TTN Web site at *http://www.epa.gov/ttn/uatw/*.

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APPENDIX O

AIR TOXICS EMISSION INVENTORY QUESTIONNAIRE ELEMENTS, CONSIDERATIONS, AND FOLLOW-UP PROCEDURES

ELEMENTS

An air toxics emission inventory questionnaire mail-out has three basic elements: the cover letter, the questionnaire instructions, and the questionnaire itself. The questionnaire format and content depends on the detail of the inventory and the ultimate use of the data. All of these components, when considered together, make up the air toxics questionnaire package.

Cover Letter

The cover letter is a key to the air toxics emission inventory, because it introduces the purpose of the questionnaire and is the initial contact with the recipient. If the cover letter does not command attention, the attached questionnaire may be discarded or filed away and not considered a top priority. This could make the number of companies requiring recontact by agency personnel increase dramatically.

The cover letter should include the following:

- Applicable regulations, if any, that require the recipient to respond;
- Confidentiality provisions, if applicable;
- The purpose of the questionnaire;
- A respectful request for cooperation in filling out the questionnaire;
- Due date for the return of completed questionnaires;
- A state or local agency contact name and telephone number to answer questions; and
- Rationale for asking for what may appear to the source to be redundant information.

The cover letter should be as short and direct as possible. The most successful return rates for questionnaires have been the ones having the strongest legal statements. Therefore, states/local agencies requiring air toxics source registration to obtain construction or operating permits may obtain better source cooperation.

A strong statement about existing and applicable regulations which require a recipient to respond to the questionnaire is the agency's most powerful tool for maximizing the return rate. The statement should be placed prominently in the beginning or at the top of the cover letter. It should cite any applicable regulations or proposed regulations and specify penalties for noncompliance.

Another important item to include in a cover letter to ensure a high return rate is the due date. The final due date should be included in the cover letter to that it will not be overlooked by those who do not read instructions. The due date may be specified either as a stated date or as a period of time after the recipient receives the questionnaire. The first approach is more specific, and gives the recipient a definite deadline. With the latter approach however, the questionnaire mailing can be staggered without having to reprint the due dates listed on the cover letter. The agency should record each due date so it will be clear when follow-up letters or phone calls may need to begin for tardy respondents.

Questionnaire Instructions

General information that affects the whole questionnaire may be included first on the instruction page. For example, if the questionnaire is "open-ended" (i.e., asks the recipient to list every toxic compound from every emission source) , it should be clear that the respondent should use chemical compound names or preferably CAS numbers and not just industrial trade names. Also, it may be helpful to point out that not all questions, sections, or pages may apply to every industry, as in a source category specific directed questionnaire. If the questions are designed for direct coding to computer input, the general instructions should explain how to enter numbers properly. In addition to explaining how to complete the questionnaire, the general instructions should indicate the specific year, or other appropriate period of time, for which all data are required.

Some agencies have utilized production/use questionnaires which basically just ask sources to identify whether each substance is purchased, used, or produced, followed by a more detailed questionnaire targeted to specific industries. Some agencies include minimum usage or emissions levels specified on an attached list as part of the instructions.

Questionnaire Design

There are several ways to design a questionnaire. Of utmost importance when designing a questionnaire is that the format suits the needs of the agency and attains correct responses and maintains a good agency-industry working relationship.

Several approaches can be taken in designing the questionnaire which, in turn, will effect the format of the questionnaire. The approaches that can be used include: open vs. closed-ended, emission-based vs. chemical use, permit related, and general vs. industry-specific. In order for an agency to decide which approach to use, it needs to be familiar with some of the impacts of each approach.

Each agency should tailor their inventory package according to their agency's individual needs. Many times, the examples are a combination of approaches. For instance, in one case a general design questionnaire was sent to various manufacturers and process industries, and later, industry specific questionnaires were sent to a small subset of the original recipients. In still another case a screening study was first done to narrow down the number of sources to be inventoried and

indicated the design needs of the final questionnaire to be sent out. Later, a second questionnaire was sent.

The following sections explain the advantages and disadvantages of various type questionnaire designs. These are not necessarily mutually exclusive.

Open-Ended Approach

The open-ended approach does not target specific source types or a limited group of compounds. The open-ended approach asks the respondent to list any compound that they emit. It does not provide a checklist of compounds. Therefore, with an open-minded approach a much larger number of contacts will be necessary. This approach has several similarities to a screening study:

- Less time and effort in questionnaire design;
- Responses may be less detailed;
- More responses may be inaccurate or trade names (not chemical compound names) may be listed; and
- Some sources may report no air toxic emissions.

Closed-Ended Approach

The closed-ended approach is a more direct approach, which usually provides a limited list of compounds with the questionnaire. Some agencies' list lists of toxic compounds are becoming rather extensive and use of CAS numbers is widespread. This approach requires more design time up from (e.g. screening studies, modeling analyses). However, the benefits are that the resulting number of sources contacted can be greatly reduced and the quality and detail of the data received are usually better.

Emissions-Based Approach

Emissions-based questionnaires request information often included in annual volatile organic compound (VOC) or particulate matter emissions inventories.

The agency may request permitted or potential emissions per source and/or actual emissions, average emissions, or emissions per day. They may also specify emissions per hour (or time interval) for specific compounds. In many cases some of this information can be collected for the majority of sources from the established criteria emission inventory records. The agency may also ask for emergency episode emissions, fugitive emissions, and information from excluded criteria emission inventory sources.

Chemical Use Approach

Chemical use questionnaires are directed toward lists of specific compounds and ask for process input information and Material Safety Data Sheets (MSDS). The Material Safety Data Sheets include the needed species composition data and should be requested where available, for any approach used. The agency can require the source to contact the suppliers of chemicals they use, if MSDS are not available. The agency can use these data to make emissions estimates if information is also provided on daily use, process operating parameters, and efficiency of the control equipment.

General Approach

This type of questionnaire may be used as input to simple screening models to determine if a particular source is a potential problem and if further, more detailed source, emissions, and modeling data are required. A list of chemicals is provided and the sources must access it if it emits any of the listed compounds. These questionnaires may list minimum levels for each compound addressed. Such questionnaires may also be used in conjunction with several source specific questionnaires. The general questionnaire may also be sent to a variety of manufacturing or industrial process facilities not covered by the source specific questionnaires.

Industry-Specific Approach

These are very detailed questionnaires that may include emissions information from process vents, fugitive equipment leaks, equipment openings, raw material/product storage and handling, secondary waste treatment, and liquid spills. Questionnaires of this type are usually focused on a handful of very large, singularly important point sources. A great deal of pre-screening effort would be required for industry-specific questionnaires, and a great deal of effort would also be required of the recipient in filling out the questionnaire. More effort would be required per source for the agency to properly interpret the response. However, this level of detail is probably the next best thing to actual source testing in estimating emissions. This technique may also prove useful in targeting particular sources the agency determines may or may not need to conduct source tests.

Tiered Approach

In the tiered or staggered mail-out approach, a cover letter and screening study type questionnaire are used, followed later by more detailed questionnaires sent to a select number or type of sources. A phone survey may be conducted by the agency prior to the screening study to narrow the number of facilities to send the screening study questionnaire or the detailed questionnaire. Whether the phone survey is conducted before or after the screening study questionnaire is sent depends on the number and type of facilities in the inventory area.

A good example would be dry cleaning establishments. The state manufacturing guide may list 100 dry cleaners in a certain city. However, after a phone survey the agency found that 75 percent of these locations are only drop-off and pick service centers. By conducting the phone

screening, it was obvious that no questionnaires were necessary for those service centers. A more detailed questionnaire was sent to the remaining 25 dry cleaners. This benefitted both the agency by not having to review unnecessary forms, and the excluded service centers by not wasting their time completing unnecessary forms. Phone screening may not always be an efficient use of agency time, depending on the individual agency needs or types of industries included.

Another approach is to first send an open-ended questionnaire or general questionnaire, followed by later designed industry specific (by source type) questionnaire, followed-up by phone calls to clarify data and/or source tests or inspections.

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OTHER CONSIDERATIONS

Other considerations when developing an air toxics questionnaire are more related to strategy for maximizing accuracy and minimizing cost and time involved to conduct an inventory. These include discussions of the importance of the following:

- Asking the right questions;
- Maximizing return rates;
- Providing for facility confidentiality of trade secrets;
- Outlining what questions are applicable for particular source categories;
- Designing question/answer style and format to decrease confusion or misrepresentation;
- Providing written instructions for answers (especially units of measurement) with computer coding format instructions if necessary; and
- Developing a data quality assurance procedure.

Some of these considerations are clearly technical in nature, but they need to be incorporated with administrative and procedural considerations for the whole effort to be the most efficient.

The Right Questions

A successful air toxics questionnaire obtains the right answers to the right questions for the particular agency while maintaining a good working relationship with the recipients. Duplication of information already available through permit files may not be needed if the number of sources included in the survey is few and the information is easily extracted from other sources. However, for large survey efforts, it may be too time consuming for agency personnel to extract needed available information and thus, some duplication of effort on the part of the sources cannot be avoided. If the sources being sent questionnaires are the same as included in the criteria pollutant inventory, all information which the agency already has about the recipient's facility, such as mailing address, SIC number, UTM coordinates, emission point numbers, etc., should be preprinted on the questionnaire. The agency could use a window envelope to expose the facility name and address and avoid making additional mailing labels.

The most profound difference between air toxics and criteria pollutant inventories is in the sheer numbers of substances included. Since there are literally hundreds of potentially toxic substances as compared to only a handful of criteria pollutants, asking the right question in all cases can become formidable. Also, data handling and data collection needs increase as more substances are inventoried. In addition, if the emission estimates are to be used as inputs to models, then the data must be collected spatially and resolved to grid cells depending on which models will

eventually be used, therefore the "right" questions to ask may vary. In general the complexity of the questions will be determined by the most demanding application to which the inventory will be applied.

The Return Rate

The return rate of a questionnaire depends on several factors. The first impression of the recipient, the simplicity of the questionnaire, and conveying the importance of returning the questionnaire are all important factors affecting the return rate.

Minimize Questionnaire Length

The recipient's first impression will be based on the size of the questionnaire. It should be as brief as possible. Unfortunately, it may be impossible for the forms and accompanying instructions for a large listing of toxic compounds or source categories to be brief. So, the next best approach may be to design the forms in such a way to make the pages as uncluttered and readable as possible leaving ample room for answers.

Maximizing Return Rates

Staggered mailing is particularly important for very large inventories, because 1000 or more questionnaires returned simultaneously may be too difficult to process at one time. Staggered return uses the agency's limited manpower and resources more economically. Questionnaires can easily become lost or damaged if they are not processed expediently by the agency, and this may be less likely to occur if the staggered mailing approach is used.

Each respondent should have an equal amount of time to respond to questionnaires when using the same format and approach especially if there is a penalty for late responses. But this must depend on equal complexity of the information required by questionnaires. Obviously more time will be needed for a large source to complete a source specific questionnaire than a simple screening survey or a general information questionnaire with, for example 20 compounds versus 200 compounds. Therefore, the time period allowed for completion of air toxics emission inventories require more planning than criteria pollutant inventories. The time period should be long enough so that the respondent is not overly rushed and short enough that the respondent does not procrastinate in responding.

Another good approach for a large inventory is to classify the mailings according to priority chemicals, source type, source size, county locations, or simply a source name (alphabetical) staggered approach. In this way, all of the questionnaires will not be returned as the same time. Each questionnaire should be reviewed as soon as possible after it is received. When this approach is used for a selected small number of sources at the beginning of the update, the agency can predict the manpower and resources it will take to complete the full-blown inventory effort. They may find they do not in fact have the manpower to conduct the type of inventory they want. They can instead rethink and replan their approach or request additional manpower to complete the inventory.

Confidentiality

Confidentiality can be established in one of several ways. The simplest is a box to be checked to request confidentiality for all information other than emissions data given in the questionnaire. Justification for the request would be given by the recipient on a separate sheet. In this way each piece of confidential information can be keyed as such.

Another approach would be for the industry to submit one full questionnaire and one "sanitized" questionnaire that would be available for public review.

The main advantage to this approach is that it clearly indicates the request to the agency. It also alerts the agency to look for supplementary supporting information. If the questionnaire is converted to computer input, a check in the confidentiality box can be programmed as a command to store all information in a limited access data file.

The disadvantages of this approach are that it does not provide confidentiality for only specific pieces of information and that it may be too easy to use. It should be used only for recipients who are anticipated to be deeply concerned about confidentiality. This judgment is best handled by the appropriate agency officials. A better method may be to require the industry to highlight each and every answer it deems confidential.

A more complex method for establishing confidentiality involves the assignment of a survey number to each questionnaire; this number would also be printed on the general information page. The agency director would detach the general information page from the returned questionnaire and store it in a locked file. Since all identification is presented on the general information page, no one would be able to associate the information on the question pages with a specific facility. If necessary, a facility could be identified by locating the survey number in the locked file of general information pages. This consideration is especially important if the agency subcontracts to a private consultant for the interpretation and transcription of the information. If the information is computerized, the identification information could be entered into a separate limited access file.

Each agency should be versed in their local laws to ascertain that the concealment of identification is not forbidden (the public access to records varies among states).

A system which allows for partial confidentiality could be established in the cover letter using a paragraph similar to the following:

Any proprietary information, which you believe is of a confidential nature, should be identified in a supplementary letter with applicable data in the questionnaire marked with the word <u>CONFIDENTIAL</u>. A brief explanation in your letter for the desired confidentiality should be included.

This system indicates clearly to the agency which information is confidential and which is not. It also alerts the agency to look for supplementary supporting information with each returned

questionnaire that is marked anywhere with the word "CONFIDENTIAL." However, unless the marking is very clear, this system can become tedious and inefficient.

Applicability and Clarity of Questions

Several factors in the design of the question section can determine the efficiency of the mailing and affect the return rate as well. First, there should be a clear statement from which the respondent can determine whether the questionnaire is applicable to his facility. Second, the questions should be well-arranged and easy to answer.

A clear statement of applicability serves several purposes. If the questionnaire is applicable, the statement reinforces the necessity of compliance. If the questionnaire is not applicable and recipient can easily determine it as such, he may be more cooperative in the future when the questionnaire does apply to him. A maximum return rate for non-applicable respondents is important because the agency will not have to waste time and money for follow-up and know up front which facilities are not being inventoried.

The use of a check box for applicability will help the agency distinguish between questionnaires that are not applicable and the ones that are returned without any response. Examples of statements of applicability are provided below.

- If this equipment was used at least five (5) days last year, check this box and complete the questionnaire.
- If this equipment was not used at least five (5) days last year, check this box and return this form.
- If this equipment has been removed, check this box and return this form.
- If any compound used on the attached table is less than the minimum level listed, check this box and return this form.

Statements of non-applicability at the beginning of each page or section can be used as an alternative or supplement to a general statement of applicability. Colored pages may be used to designate different sections of the questionnaire. By supplying a check box, the agency can discriminate between pages that were forgotten and pages that were not applicable.

Complexity and Questionnaire Format

As mentioned earlier, the questions must be well-arranged and easy to answer. Brevity enhances the rate of return. The agency can usually reduce the bulk of the question section by designing industry-specific questionnaires instead of general questionnaires. Industry-specific questionnaires are designed specifically for one particular type of industry, as opposed to general questionnaires applicable to a whole group of industries. For example, it may be better to send

an industry-specific questionnaire to a dry cleaning establishment and a multipage, general questionnaire to an organic solvent user.

The consideration of questionnaire format, however, must be balanced against the level of resources available to the agency conducting the inventory. It takes more money and manpower to design, mail out, and interpret industry-specific questionnaires than it does general questionnaires. Processing of industry-specific questionnaires is also more complex because the format of each questionnaire will vary. Furthermore, it is possible to send an inappropriate industry-specific questionnaire to a facility. On the other hand, general questions may be preferable if the agency's resources are limited or if the agency is unfamiliar with many of the sources. Inventories for specific pollutants may be most advantageously conducted with general questionnaires. Furthermore, general questionnaires may be more appropriate for large or complex facilities that are difficult to characterize. Most of these facilities will have engineers available to translate their process and emission information onto the forms.

If a general questionnaire must be used, it is important to provide a statement of applicability for each page. In addition, questionnaires that are organized so that all information about each emission point can be provided on one page are usually easier to fill out than questionnaires that have separate pages for process, emissions, control equipment, and stack information (subject-by-subject). For this reason, source-by-source questionnaires are usually considered the better format. However, if the questions are arranged by subject, industry-specific questionnaires can be designed by simply selecting the subject pages that apply to each industry. Then only a few supplementary pages of questions that are unique to an industry must then be formulated.

Another method that can minimize the level of effort required from the recipient, and therefore enhance the return rate, concerns the format of the questions. Multiple choice questions are the easiest type for recipients to answer. Many questions can easily be formatted as multiple choice. For example, a question that asks the recipient to describe or name the type of control device used can be improved by supplying a list of conceivable control devices and asking the recipient to put a check next to the appropriate answer. When needed, multiple choice questions can include the choice "other" with a blank beside it for entering out-of-the-ordinary controls. Other questions, such as those that require exact numerical answers, can only be answered appropriately with a written response. If there are repetitive questions, the recipient could be asked to make a copy of a questionnaire for each point source or substance being inventoried.

Clarity of Instructions

To be considered accurate, questionnaire responses must provide both the descriptive information desired and the correct numerical data. Every effort must be made not to confuse the recipient. Therefore, it is important to provide clear, complete instructions to decrease the chances of error in the responses. Instructions should be as concise as necessary. Units of measurement, method of calculations and conversions, and code number instructions should be put <u>on</u> the questionnaire itself and <u>not</u> explained in the instructions. This enables the recipient to read through instructions expediently without becoming caught up in too much detail.

In conclusion, general instructions should be as precise as possible. Some of the most effective air toxics questionnaire instructions are those which explain in detail how to answer each question. If a particular question requires special clarification, it is best to note special instructions on the same page as the question rather than print them on a separate instruction page.

The following types of information should be included when asking detailed questions:

- Specific Responses--printing the type of units wanted for an answer right next to the answer space. Using the multiple choice format;

- Samples--providing completed samples with the instructions for process flow, schematic and plant layout diagrams. Sample diagrams help the recipient to visualize what is expected; they are easiest to interpret if they are adjacent to the instructions;

- Standardized Forms--providing standardized forms when periodic inventory updates are performed. Regular recipients will eventually learn how to provide the correct responses. This is one condition under which a single generalized form for all facilities is efficient;

- Emissions Estimates--instructions for the inclusion of estimation methods used. Examples of estimation methods include: material balance, emission factors, source test results, models, and engineering judgments.

Final Considerations

After a questionnaire is designed, it is good quality assurance procedure to check its effectiveness. This can be accomplished using a limited pilot mailing followed by site visits. This procedure provides a check on the effectiveness of the particular questionnaire package and its applicability to different sources. A final possibility that may improve industry-agency relations would be to include a few questions at the end of the questionnaire or on a separate page for industry suggestions for future questionnaires or questions such as the following:

- Were the questions clear?

- Approximately how long did it take to complete the form?

- Were the questions applicable to your company?

- If you called for help and/or agency clarification, did we adequately respond?

- Was the time allowed after receiving the questionnaire adequate? If not, why?

- Please provide additional comments, if any.

This type of addition may indicate to the recipients a true concern to minimize industry paperwork, or at least the desire to work with industry to improve future questionnaires.

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FOLLOW-UP PROCEDURES

Follow-up can be as important or more important than the planning and effort expended in questionnaire design. The accuracy and completeness of responses must be checked and tabulated, and entered into a computer. Depending on how thorough the questionnaire instructions were explained with the mail-out, and whether deadlines were identified in the cover letter, a second major effort may be required to contact recipients who are delinquent in responding or to clarify items such as emissions units or estimates of control efficiencies. Some second effort can be expected, either for clarification of answers or for non-response. The following sections discuss the importance of such follow-up procedures such as data quality checks, the use of on-site inspections, and recontacting sources. Questionnaire revisions are also discussed.

Quality Control of Data

All the questionnaires should be checked by engineers, chemists, or experienced environmental scientists to determine if the data provided are reasonable. It is helpful to ask for process flow and plant layout diagrams to aid in the interpretation of data. In addition, the best quality check would be performed by engineers or scientists who have worked in or are familiar with the industry. Finally, for similar processes and chemicals, total emissions can be compared against each other or checked against appropriate emissions factors to determine reasonableness. The extent that detailed checks can be done depends on the resources available to the agency, the number of sources included in the inventory, and the use of the data. It is suggested to recontact a higher percentage of respondents that considered their usage lower than specified yearly amount, or as having no toxic emissions when their SIC code would suggest otherwise. Perhaps they only misunderstood the way the instructions were worded, or know their chemicals by a trade name instead of chemical composition. In any event, a follow-up call may increase the accuracy of the inventory.

On-Site Inspections

For certain sources, it may be appropriate to consider plant visits if more specific information needs to be obtained for a particular program purpose, although this approach can become resource intensive and time consuming. Another approach is to do a preliminary screening and visit a very small percentage of facilities as part of a data quality control procedure. Also, it may be wise to visit a representative sample of respondents that checked the “not applicable” box, especially if the agency determines from cross referencing SIC codes, that the source has a potential to emit air toxic compounds.

Another less resource intensive approach may be to inspect the facility to check air toxics emission responses during the next regularly scheduled air compliance inspection. Most agencies periodically inspect major facilities within their jurisdiction. The problems that can be encountered using this approach is that air inspectors may need additional training before such air toxics inspections, because most regular air inspections involve criteria pollutants, or at the most select pollutants associated with NESHAPs or NSPS.

Recontacting Sources

The return rate for the air toxics questionnaires can be increased by recontacting recipients that are delinquent in responding either by letter or by phone. This recontact reminds them that they will not be forgotten and may be subject to fine, and that a response is necessary. For other companies that may be confused by some of the questions, recontact provides them with a less embarrassing way to ask questions. This interaction is the most effective while the questionnaire is being initially completed, rather than having to return questionnaires to the industries for corrections. Using a pilot mailing will help get an idea of the average time recipients take to respond and how many recipients will need to be recontacted. In addition, a pilot mailing can provide an overview of the effectiveness of the questionnaire before the final mailing is done. Unnecessary recontacts should be minimized to avoid the possibility of some firms becoming uncooperative. Inventory efforts, after all, are not a one-time need. Yearly updates may be necessary.

Revising the Questionnaire

The process of revising the questionnaire should be an evolving process. With each mail-out or updating of the inventory, the questionnaire or instructions for completing the questionnaire can be fine tuned or redirected to meet the developing air toxics program needs. But, as mentioned before, industry will become familiar with questionnaire format that is not changed drastically from mailing to mailing. So, a carefully considered initial design is the best approach, and will reduce time needed for follow-up.

Some changes can be expected, such as:

- Promulgation of new air toxics regulations, stricter source registration requirements, or changes in reporting requirements;
- More EPA approved emission factors or more available stack test data;
- Increases in the number and types of compounds included;
- Changes in format of questions when agency installs or changes its data handling system; and
- Changes in air toxics control technology and/or control equipment efficiency.

Other changes may be made because of the widespread occurrence of wrong responses to a particular question. Still another kind of revision, but one that has much impact, are changes in various aspects of the inventory process, such as:

- Addition or deletion of the use of screening questionnaires;
- Changes in the cover letter, instructions or confidentiality provisions;

- Changes in the type of questionnaire, such as a change from open-ended to industry-specific questionnaires;

- Changes in the ways that the agency intends to use the data; and

- Changes in agency budgets and/or resources and manpower available for inventory efforts.

Perhaps the best way to proceed is not to plan in terms of needed air toxics emission inventory questionnaire revisions, but to continually focus on needed improvements, whatever the reasons turn out to be.

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APPENDIX P

LIST OF PUBLISHED L&E DOCUMENTS

http://www.epa.gov/ttn/chief/ap42etc.html#LE

List Of Published L&E Documents

Substance	EPA Publication Number	Available On Line?
Acrylonitrile	EPA-450/4-84-007a	NO
Arsenic	EPA-454/R-98-013	YES
Benzene	EPA-454/R-98-011	YES
Butadiene	EPA-454/R-96-008	YES
Cadmium	EPA-454/R-93-040	YES
Carbon Tetrachloride	EPA-450/4-84-007b	NO
Chlorobenzene (update)	EPA-454/R-93-044	YES
Chloroform	EPA-450/4-84-007c	NO
Chromium (supplement)	EPA-450/2-89-002	YES
Chromium	EPA-450/4-84-007g	YES
Cyanide Compounds	EPA-454/R-93-041	YES
Dioxins and Furans	EPA-454/R-97-003	YES
Epichlorohydrin	EPA-450/4-84-007j	YES
Ethylene Dichloride	EPA-450/4-84-007d	NO
Ethylene Oxide	EPA-450/4-84-007l	YES
Formaldehyde	EPA-450/4-91-012	YES
Lead	EPA-454/R-98-006	YES
Manganese	EPA-450/4-84-007h	NO
Mercury	EPA-453/R-97-012	YES
Methyl Chloroform	EPA-454/R-93-045	YES
Methyl Ethyl Ketone	EPA-454/R-93-046	YES
Methylene Chloride	EPA-454/R-93-006	YES
Nickel	EPA-450/4-84-007f	NO
Organic Liquid Storage Tanks	EPA-450/4-88-004	NO
Perchloroethylene and Trichloroethylene	EPA-450/2-89-013	NO
Phosgene	EPA-450/4-84-007i	NO
Polychlorinated Biphenyls (PCBs)	EPA-450/4-84-007n	NO
Polycyclic Organic Matter (POM)	EPA-454/R-98-014	YES
Styrene	EPA-454/R-93-011	YES
Toluene	EPA-454/R-93-047	YES
Vinylidene Chloride	EPA-450/4-84-007k	YES
Xylenes	EPA-454/R-93-048	YES

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APPENDIX Q

LIST OF RELEVANT WEB SITES

List of Relevant Web Sites

Technology Transfer Network (TTN):
http://www.epa.gov/ttn/

Basic emission inventory preparation procedures:
http://www.epa.gov/ttn/chief/

Compilation of Air Pollutant Emission Factors (AP-42):
http://www.epa.gov/ttn/chief/ap42etc.html

Locating and Estimating (L&E) documents:
http://www.epa.gov/ttn/chief/ap42etc.html#LE

POM L&E documents:
http://www.epa.gov/ttn/chief/pom.html

Factor Information Retrieval (FIRE) Data System:
http://www.epa.gov/ttn/chief/fire.html or (919) 541-5285

TANKS
http://www.epa.gov/ttn/chief/tanks.html

WATER8 and CHEMDAT8:
http://www.epa.gov/ttn/chief/software.html#water8

Air ClearingHouse For Inventories And Emission Factors (Air CHIEF) CD-ROM:
http://www.epa.gov/ttn/chief/airchief.html#order

The TTN CHIEF Forum:
http://www.epa.gov/cgi-bin/netforum/chief/a/1

Unified Air Toxics Web site (UATW):
http://www.epa.gov/ttn/uatw/

Section 112(c)(6) list:
http://www.epa.gov/ttn/uatw/112c6/112c6fac.html

Section 112(k) Integrated Urban Air Toxics Strategy list:
http://www.epa.gov/ttn/uatw/112k/riurban-html

Unified Air Toxics Web site Forum:
http://www.epa.gov/cgi-bin/netforum/uatw/a/1

Federal and Regional Agencies Contacts:
http://www.epa.gov/ttn/uatw/epaprogs.html

Air Toxics Rules, Rule Development and Implementation Information**:**
http://www.epa.gov/ttn/uatw/eparules.html

Unified Air Toxics Web site Technical Resources:
http://www.epa.gov/ttn/uatw/techres.html

Aerometric Information Retrieval System (AIRS) - Main Menu:
http://ttnwww.rtpnc.epa.gov/html/airs/airs.htm#ASIR

Office of Air & Radiation:
http://www.epa.gov/oar/

Section 112(m) Great Waters Program list:
http://www.epa.gov/oar/gr8water/report97.html

EIIP documents:
http://www.epa.gov/oar/oaqps/eiip/

Office of Air Quality Planning and Standards (OAQPS):
http://www.epa.gov/oar/oaqps/

AIRSWeb:
http://www.epa.gov/airsweb/sources.htm

The Aerometric Information Retrieval System (AIRS):
http://www.epa.gov/airs/

OAQPS Emission Inventory (EI) Public Forum:
http://www.epa.gov/cgi-bin/netforum/nei/a/1

Office of Research and Development (ORD):
http://www.epa.gov/ord/

Integrated Risk Information System (IRIS):
http://www.epa.gov/ngispgm3/iris/subst-fl.htm

Ambient Monitoring Technology Information:
http://www.epa.gov/ttn/amtic/

Clean Air Technology Center (CATC):
http://www.epa.gov/ttn/catc/

The Landfill Air Emissions Estimation Model:
http://www.epa.gov/ttn/catc/products.html#software

Office of Pollution Prevention and Toxics (OPPT):
http://www.epa.gov/opptintr/

Toxic Release Inventory (TRI) data:
http://www.epa.gov/opptintr/tri/access.htm

Emission Measurement Technical Information Center (EMTIC):
http://www.epa.gov/ttn/emtic/

Emission Measurement Technical Information Center (EMTIC) guidance on emission testing:
http://ttnwww.rtpnc.epa.gov/html/emtic/emtic.htm#EM02

STAPPA/ALAPCO:
http://www.4cleanair.org/about.html

The Great Lakes Commission:
http://www.glc.org/

California Air Resource Board:
http://www.arb.ca.gov/homepage.htm

California's Hot Spots Air Toxics Program:
http://www.arb.ca.gov/toxics/toxics.htm

Dun and Bradstreet Million Dollar Directory:
http://www.dnb.com/

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